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A Study to Develop Statewide and County-Level Economic Projections

Volume II: Methodology

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

AIR RESOURCES BOARD
Research Division

A Study to Develop Statewide and County-Level Economic Projections

Volume II: Methodology

Final Report

Contract No. 92-326

Prepared for:

California Air Resources Board
Research Division
2020 L Street
Sacramento, California 95814

Prepared by:

Jay Kloepfer

DRI/McGraw-Hill
425 Battery Street, 5th floor
San Francisco, California 94111

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Introduction & Overview

The California Clean Air Act (CCAA) requires that districts not attaining State ambient air quality standards must develop plans to demonstrate their progress towards attainment of these standards. These plans require non-attainment areas to show a 15 percent reduction in emissions for each three-year period until they reach attainment. The ***emission inventory*** conducted in 1987 is used as the base year to measure progress toward the 15 percent reduction.

The Air Resources Board is required by the California Health and Safety Code Section 39607(b) to prepare this inventory of sources of air pollution within ***all*** air basins of the State and to determine the kinds and quantities of the air pollutants that come from these sources. The inventory and projections of future pollutant levels are used by the State and the districts for a variety of purposes including developing air resources management plans, evaluating control measures, analyzing new source impacts, modeling air quality, and measuring control program effectiveness.

The ARB maintains an emission forecasting model that is used to project emissions by industry categories for each air basin in California, and to track historical and projected emission trends statewide. To demonstrate that their CCAA plans will achieve the required emission reductions, most of the air pollution control districts use emission forecasts that are derived from the ARB's model. A major component of the emission forecasting model is the economic activity profiles which are used to project industrial and commercial growth in California. Future year emissions for each combination of growth and control categories for a county portion of an air basin are calculated using the following equation:

$$E_{fy} = E_{by} * GF * CF$$

where:

E_{fy} = emissions for future year

E_{by} = emissions in the base year

GF = growth factor which is also a ratio of activity in the future year to activity in the base year

CF = control factor, which is also a ratio of the relative amount of control in the future year to the amount in the base year

It can be seen from this simple equation that growth factors, which are dependent on national and state economic conditions, play a crucial role and could be a large source of uncertainty in the forecasts of future year emissions. The air pollution control districts use ARB emission data and projections in developing control strategies to meet the CCAA's emission reduction requirements, so it is important that the ARB use the latest available historical data and the most reliable, credible, and accurate projections of economic activity.

The ARB's present economic activity profiles were last updated in 1988. With so many changes in California's economy, these historical data are clearly outdated, and the overall outlook for the State has been altered dramatically. It is essential for the ARB to update the historical data and revise the projections in the county and state economic activity profiles in order to maintain the integrity and credibility of its emissions forecasts.

Project Objectives

The need for updated historical data and accurate forecasts of economic activity has led to the work performed under this contract between DRI/McGraw-Hill (DRI) and the California Air Resources Board. The objective of this project was to develop a detailed data base of employment and real output projections, by specified industry groupings, for the state and each county in California. These projections are based on the most recent economic data available, and include historical observations back to 1970. Four scenarios have been developed, each reflecting a possible path that the California economy can reasonably be expected to follow over the next 27 years: base case or best estimate, optimistic, pessimistic, and business cycle. The projections will be used as inputs into the emission forecasting model of the Air Resources Board.

Project Results

Using the DRI ***California Long Run County Employment and Output Forecasting System,*** developed for the ARB under contract A3-237-32, DRI focused on developing sound statewide and county-level projections of employment and real output. Specific tasks included:

- Preparation of an historical data base of real annual production (in constant $1977) and employment by industries, at the detailed two-, three-, and four-digit SIC code levels as specified by the ARB, for all of California and for each county in the state from 1970 to 1992. DRI developed these data from the DRI Data Base, including publicly reported statistics as well as proprietary data on labor productivity and output, and augmented these data with information from the California Employment Development Department, the U.S. Department of Commerce, and the U.S. Bureau of Labor Statistics.

- Projections of real annual production and employment by industries, at the level of detail collected for the historical data base, for all of California and for each county in the State from **1993 to 2020**. Four separate projections have been prepared for each of four scenarios: business cycle, high growth or optimistic, low growth or pessimistic, and best estimate or base case.

- Complete documentation of the historical data, forecast methodology, and the employment and output projections in two volumes. Volume I describes the DRI forecasts at the national, state, metropolitan area, and county levels, and includes summary tables of employment and output, by SIC code, for each county. Volume II is a methodological review that explains the DRI forecasting system and the components required to derive the employment and real output projections. Volume II also includes a description of the data collected for this study, and the process undertaken by DRI to ensure the integrity and consistency of the data. County summary tables of employment and output are contained in Volumes III - VI.

- The complete historical and forecast data base delivered on a magnetic tape for use by the ARB through the State Teale Computer Center.

- On-site presentation of the DRI data and methodology to ARB staff and the constituent users from the regional air quality management districts.

DRI developed the ***California Long Run County Employment and Output Forecasting System*** in 1986 in cooperation with the ARB staff, and used the System to successfully prepare updates of the projections in 1988. DRI enhanced the System in 1989 under contract to another State agency to expand the forecast coverage to the four-digit SIC code level for each county. This complete forecasting System integrates DRI's regular national, state and county economic forecasts with our inter-industry analysis to provide projections of county-level industry employment and real output. In addition to developing and maintaining this customized forecasting System, DRI maintains and updates all of the data required to prepare the historical data base and produce the annual projections.

Methodological Approach To Forecasting Employment And Output In California Counties

The purpose of this methodological review is to explain the economic forecasting system employed by DRI to prepare the projections of employment and real output, by industry, by county. In particular, this volume will describe the interactions among the components of the system, and how additional information at each step in the system is brought to bear on the problem of accurately predicting economic growth by industry.

The California Long Run County Employment and Output Forecasting System

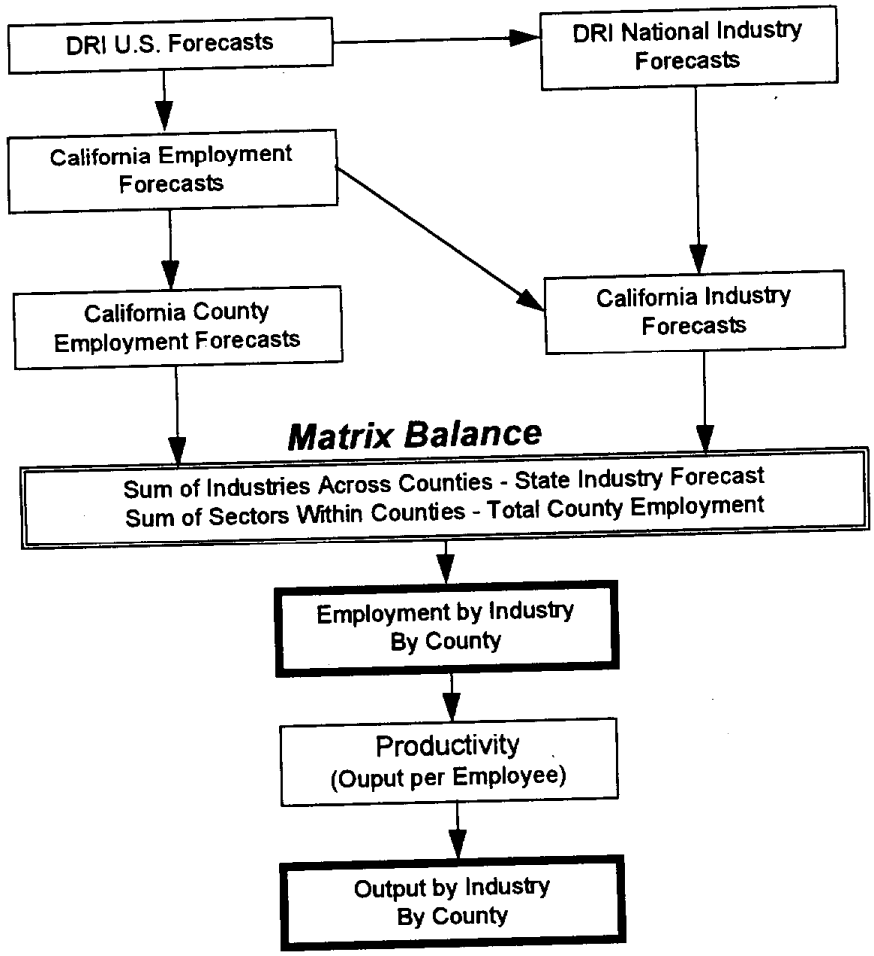
The ***California Long Run County Employment and Output Forecasting System*** provides an integrated framework for producing reliable county employment and real output forecasts, and is ideally suited to produce alternative analyses. First, national economic trends are analyzed using the DRI model of the U.S. economy, and economic effects federal policy changes or international events are quantified. Next, the Regional model provides forecasts of California employment under these national policy and economic assumptions. In addition, the Regional model measures California performance based in part on factors affecting its competitive advantages. Third, the interaction among industries is analyzed using the Industry model, and the impact of potential technological change is evaluated. Fourth, the link between California's industries and national industry technology is uncovered. Fifth, variation among California counties is projected and a structure is established that enables changes in county industrial mix to be incorporated. Sixth, consistency is maintained between state and county aggregates by a matrix balancing technique. Lastly, real industry output is projected by examining labor productivity trends and county production worker data.

The structure of this System is diagrammed in the flow chart titled Chart 1. Each box in the diagram is a component of the System that represents important information that is required to produce the subsequent forecasts of California counties. In order to get a complete understanding of the forecasting process, each box of Chart 1 is explained following the chart.

Chart 1

Overview of DRI Methodology

DRI California Long-Run County Employment and Output Forecasting System



1. National Macro-Economic Trends - policy assumptions that affect any projection of future trends.

National economic and policy assumptions set the stage for all state and regional analysis. The DRI Model of the U.S. Economy is a tool widely used to produce forecasts under different policy assumptions and changing national and international economic environments. DRI produces forecasts of the U.S. economy on a regular basis, including best estimate and alternative scenarios.

The model blends insights from many theoretical schools--Keynesian, neo-classical, monetarist, supply-side and rational expectations--in its interpretation of short-run, private sector behavior. One particularly distinguishing extension beyond other macro-econometric models is the careful integration of this behavior with a long-term growth model following the work of James Tobin and Robert Solow. Another is the expanded representation of international and government policy responses to domestic economic phenomena. These two features significantly improve the model's accuracy and utility in its two primary applications, policy evaluation and short- to long-run forecasting. Finally, the model is relatively large (1215 variables) to provide sector specificity required for commercial and regional planning. ***Appendix VII*** contains a detailed description of the philosophy, structure, and properties of the DRI Model of the U.S. Economy.

Table 1 provides an overview of the policy assumptions used in the DRI long-term forecast embodied in this study. Volume I of this report contains a full explanation of the assumptions and projections in the long-term forecast.

Table 1
Capsule Summary of the Long-Term Projections

I. Principal Policy Dimensions	
Tax changes	Small, steady increases in personal income tax rate from 1997 through 2011; rising sharply thereafter.
Growth of federal government purchases	Real, -0.5% per year; nominal, 3.2%. Real military purchases fall through 2003, then resume slow growth.
Transfers	Real growth of 2.6% per year.
Budget deficit	The federal budget deficit averages only 3.0% of GDP.
Average federal government share of GDP	23.5%
Monetary policy	Sufficient funds made available to promote stable credit growth. Money (M2) growth averages 5.7%.
Federal funds rate	Rises from 3.1% in 1993 to 5.5% in 1999. Averages 5.3% between 2000 and 2018.
Nonborrowed reserves	Growth averages 3.9% per year.

2. California Employment Forecasts - providing insights into California's competitive advantages relative to other states.

The direction of the California economy, as well as the effects of assumptions made at the national level on the State are predicted using DRI's Regional Econometric Model. The model compares California's competitive position along several dimensions with other states and regions of the country. Regional competition is an essential component of employment growth, and is a function of any or all of the following:

- Quality of life
- Home prices
- Unionization
- Wages
- Education
- Climate
- Business Cycle
- Market Pull
- Electricity Prices
- Taxes

While the overall long-term characteristics of the California economy are determined by the Regional model, within the California economy each industry must be studied to determine the important trends which may affect the competitiveness of the State's industries. ***Appendix II*** contains a detailed description of the DRI Regional model.

3. National Industry Forecasts - providing insights into trends in California industries' structure and technological change.

The structure of industries is investigated by analyzing the national input/output tables for production relationships and inter-industry flows. At the national level, 432 industries are analyzed. ***Appendix III*** provides a list of those industries, and for reference, the corresponding standard industrial classification (SIC) codes. The input/output model, which is the basis of the national industry forecasts, is a model of production which takes into account the inter-dependencies among producing sectors in the economy. The assumptions underlying this model make it possible to accept the data recorded in the input/output table as portraying the technology of production activities in the economy. The role of technology in the input/output model is central in determining the relationships among inputs and between inputs and outputs. Since technology remains relatively stable over time, it provides a firm foundation for analyzing the inter-industry flows within the economy as well as forecasting future economic performance. Appendix VI presents the methodology behind the national industry forecasting model.

4. California Industry Forecasts - providing the link between California employment and national industry forecasts.

The combination of competitive advantage, defined by the Regional model, and technological change, defined by the Inter-industry Model, is the basis for California industry forecasts. The major assumption in this approach is that California industries have the same structure as industries at the national level. In a smaller state this assumption would have to be examined carefully, but since California industries comprise a large proportion of national industries, as Table 2 indicates, the results will not be compromised. In general, the larger the state as a proportion of the nation, the closer the industry structure. California accounts for a total of 11.4% of all employment in the US.

Table 2
California's Share of Employment
Selected Industries - 1987

Industry	Share of Nation (%)
Apparel	11.4
Furniture	12.5
Petroleum	19.1
Electrical Machinery	19.1
Transportation Equipment	15.7
Instruments	17.6

County Business Patterns is a data base containing the number of establishments, total employment, and payroll for enterprises in each county. The level of industry detail provided corresponds to the four-digit SIC code (See ***Appendix I*** for a complete listing). The coverage includes industries covered by the U.S. Social Security System. The data for County Business Patterns are extracted from the Bureau of the Census Standard Statistical Establishment List (SSEL). The SSEL is updated annually by the Bureau of the Census and consists of data from the Internal Revenue Service and Bureau of the Census Economic Censuses and Annual Organization Surveys.

Employment data in this program represent all employment covered by the Federal Insurance Contributions Act (FICA). These include all covered wage and salary employment of private nonagricultural employers and nonprofit organizations, and all employment of religious organizations covered under the elective provisions of FICA.

The Bureau of the Census separately tabulates central administrative offices and auxiliaries at the division level only. Therefore, industry breakouts of private sector data at the two-, three-, or four-digit level exclude these groups. Auxiliaries are commonly defined as units at different geographic allocations which serve the manufacturing establishment rather than the general public (e.g., storage warehouses, power plants, research laboratories, garages, etc.). However, while the Bureau of the Census does separate the production facility from the sales facility, it does not separate productions workers from non-supervisory personnel within any given production facility.

Data is excluded for any industry that does not have at least 50 employees in the county. At the four-digit SIC code level and the county geographical level, this can result in gaps in the data. In order to fill in the large number of data suppressions resulting from the Census Bureau's commitment to confidentiality, National Planning Data Corporation (NPDC), in cooperation with DRI, has employed a technique called iterative proportional fitting to create an enhanced County Business Patterns database.

The resulting database represents a significant improvement over the published County Business Patterns database. The greater coverage of the database allows more analysis at the county level where there are ordinarily suppressions of data for smaller establishments.

Once the California industry mix is defined by the County Business Patterns data, national industry growth rates are used to forecast this mix. The results are then constrained at the two-digit SIC code level to be consistent with the California employment forecast from DRI's Regional model. A simple example

will serve to illustrate this process. Consider two industries, SIC codes 2013 and 2026, whose sum completely defines the two-digit SIC code 20, food processing. In other words in 1991, if industry 2013 employed 400 people and industry 2026 employed 800 people, the food processing industry would by definition employ 1200 people (800 + 400). Let's assume that, at the national level, industries 2013 and 2026 are projected to increase employment at 4% and 5% respectively, per year. And at the state level, food processing is projected to grow at 3% per year based on projections from the Regional Model. Then the first year of the forecast for industry 2013 in the state will be calculated as follows:

National industry growth rates applied to state levels,

Industry 2013	400*1.04=416
Industry 2026	800*1.05=840
Total	(840+416)=1256

However, independent from the Regional model food processing is projected to grow at 3% yielding a forecast of employment of 1236 (1200*1.03). Therefore, the results from above are constrained to sum to 1236 by proportionally adjusting each of the industry forecasts.

Industry 2013 forecast = 416 + (1236-1256) * 400/1200 = 409.3

Industry 2026 forecast = 840 + (1236-1256) * 800/1200 = 826.7

The forecast is thus constrained to the state forecast of the 2-digit SIC code 20, food processing. A detailed discussion of this methodology is provided in ***Appendix IV***.

5. California County Employment Forecasts - providing for economic variation within county economies.

Variation among industries within counties does exist. To capture this variation an econometric modeling component has been added which produces employment forecasts by ***one-digit SIC*** code for each county. While all sectors are important to the functioning of a county economy, the manufacturing sector is the focus of the model because it provides the majority of "export" activity which fuels growth in the economy. Employment in the manufacturing sector is a function of the mix of industries in a county.

The industry mix for each county is captured in the 1989 County Business Pattern data. As a first step, a total "generated" employment forecast is produced, assuming each county's industry mix remains constant. This concept is derived by combining the State's employment figures for each industry with each county's share of the state totals. A statistical relationship is then developed between the generated and actual county employment levels. The result is a forecast accounting for changing industry mix within counties. In addition, any exogenous facts (plant closings, for example) can be accounted for directly.

As the focus of the model, employment in the manufacturing sector is a function of the mix of industries in a county. Assuming this mix remains constant, a total "generated" employment forecast is produced. This concept is derived using the State's employment figure for that industry multiplied by the 1986 county's share of the state total employment for the industry. A statistical relationship is then developed between the generated and actual county employment levels using the following formula:

$$(1.1) \quad EMD@CTY = EMD@CTY\backslash 1 * (RATIO)^{K} * (GEMD@CTY/GEMD@CTY\backslash 1)$$

where

EMD@CTY=Durable manufacturing in the county.

EMD@CTY\1=Durable manufacturing lagged one year.

RATIO=The ratio between the reported durable manufacturing employment and the generated manufacturing concept (explained below (GEMD@CTY).

K=Exponent with value of one in 1983, declining to zero in the year 2000.

GEMD@CTY=Generated durable employment for the county

This process is best understood by using a simple example. In addition, a more detailed explanation is provided in ***Appendix V***. Consider a county with only two durable manufacturing sectors, A and B. County sector A has 10% of state employment in Sector A and county sector B has 20% of state employment in Sector B. Therefore, for each year of history the generated county durable manufacturing value would be calculated by the following formula:

(1.2) GEMD@CTY-.10 * SECTORA@STATE + .20 * SECTORB@STATE

where:

GEMD@CTY=Generated durable employment for the county

SECTORA@STATE=Sector A employment in the state

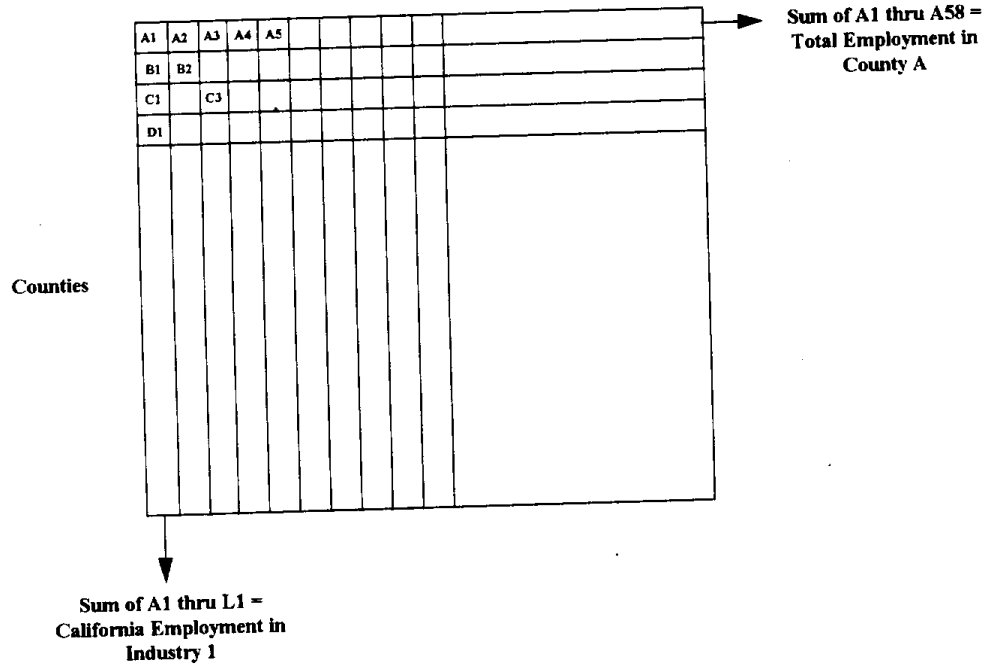
SECTORB@STATE=Sector B employment in the state

The forecasted value for the state Sector A and Sector B is provided by the DRI's Regional Information Service. Therefore, the generated county durable manufacturing total can be calculated over the forecast interval. The relationship between the generated level and the actual level is embodied in equation (1.1). Equation (1.1) is solved and produces a forecast for durable goods manufacturing by county. The result is a forecast accounting for changing industry mix within counties. In addition, any exogenous factors (plant closing required by more stringent regulations, for example) can be entered manually.

6. Matrix Balance - providing consistency between county and State forecasts.

All the pieces are now in place to produce the required forecasts of each California country. Chart 2 summarizes the structure of the base year matrix (in this case the base year is 1991).

Chart 2. Structure of Base Year Matrix



The rows correspond to county employment of each industry; for example cell A1 is County A's employment in Industry 1 and cell A2 is County A's employment in Industry 2. The columns correspond to each county's employment in a particular industry (The industry classifications correspond to the Bureau of Economic Analysis (BEA) definitions of industries used in the input/output classification scheme - see Step 8 below and ***Appendix I***). For example B1 is County B's employment in Industry 1, C1 is County C's employment in industry 1 and so on. Addition across any one row will equal each county's total employment levels for the base year; addition down any one column will be equal to California employment total for that particular industry.

Given the forecast for county employment (from the California County forecasting model) and State industry employment (from the California Industry forecasting model), each forecast year row and column total are known. DRI then adjusts each cell so that the sum of the columns and the sum of the rows will be equal. ***The underlying concept is that the individual forecasts of county employment by SIC code are consistent with the State totals for each industry and the county totals.*** The basic method used to make the adjustment to the base year matrix to account for growth in county employment and growth in state industry employment is known as the R.A.S. method, or bi-proportional matrix adjustment, and was developed in Cambridge, UK. around 1960. It is a statistical method of adjusting a matrix to fit new constraints. The basis for this method consists of finding a set of multipliers to adjust the columns so that the cells in the adjusted matrix will sum to the required row and column totals relating to the forecasts year.

7. Employment by Industry by County - providing forecasts of employment by industry within each of the 58 counties.

Once the matrix is adjusted for each year of the forecast, employment by county by industry can be read directly from the matrix.

8. Employment by Four-Digit Standard Industrial Classification (SIC) by County

The industrial classification used by the DRI Industry Service corresponds to the Bureau of Economic Analysis (BEA) definitions of industries used in the input/output classification scheme. ***Appendix III*** provides SIC code definitions of DRI Industry classifications. In most cases there is an exact correspondence between industry classification and four-digit SIC code. Where there is not an exact correspondence, a mapping based on similarities in industry structure has been constructed by DRI. The enhanced County Business Patterns data base identifies four-digit SIC code industries in each California county. Each of these four-digit industries has been mapped to a corresponding DRI industry, and is listed in ***Appendix I***. The subsequent forecasts by SIC code are derived by applying industry growth rates to the four-digit SIC code base year.

The two- ,three- and four-digit SIC code data are then aggregated into the 66 industry categories specified by the ARB. A listing of these categories is provided in each of Volumes III - VI.

9. Output by Industry by County - providing output (constant dollar) measures of industry activity in each county.

Real output per employee is assumed to be the same for California industries as it is for national industries. Once employment forecasts are produced by county by industry, it is a simple matter to multiply the employment level by output per employee (assumed to be the same as the national level) to derive constant dollar ($1977) estimates of output by industry for each county. The output per employee is combined with the employment data at the 432-sector input/output classification, mapped to the four-digit SIC definitions, and then aggregated to the 66 ARB industry categories to arrive at real output by industry.

10. Summary

DRI has constructed a unique combination of forecasting models that provide the basis for systematically analyzing and predicting growth in industries in California counties. DRI's approach combines input/output and econometric modeling techniques, resulting in a System that captures the strengths of both while minimizing the weaknesses of each. DRI can produce real output and employment forecasts for each California county in an integrated system that takes advantage of:

1. DRI's renown national economic and industry forecasts under different sets of economic assumptions;
2. The DRI California economic forecast of industry sectors consistent with the national forecast assumptions;
3. A sophisticated apportionment methodology for estimating county level economic forecasts that are consistent with both national and state assumptions; and
4. A framework for quickly evaluating the effects of national economic changes on the state, county and emission forecasts.

The steps required to produce an output forecast also provide the structure for analysis of alternative scenarios. First, national economic trends which are the consequence of a particular policy environment or set of events are analyzed using the DRI model of the U.S. economy. The framework of the macroeconomic model allows any hypothetical policy or economic changes and the resultant economic effects to be quantified for subsequent impact on California's industrial production. Second, the Regional model provides forecasts of California employment under a set of consistent national policy and economic assumptions, as well as assumptions particular to California. In addition, the Regional model measures California's performance based in part on factors affecting its competitive advantages. With this configuration it is possible to analyze alternative scenarios that will have impacts that differ in California relative to the rest of the U.S. because of California's unique economic infrastructure. Third, the interaction among industries is analyzed by using an input/output model. The implication of

technological change implies that producers change the combinations of inputs -- materials, labor, capital -- needed to produce a good. DRI's input/output framework recognizes the introduction of new technology, and allows the impact of alternative production technologies to be analyzed. Fourth, the link between California's industries and industry production technology is analyzed. Fifth, variation among California counties is projected and a structure established that enables all hypothetical changes in county industrial mix to be examined. Sixth, consistency is maintained between state and county aggregates by a matrix balancing technique. Lastly, industry output is projected by examining labor productivity trends and county employment data.

Development of Historical Data Base

As an integral component of the forecasting system, DRI prepared an historical data base of real annual production and employment by industries, at the detailed two-, three-, and four-digit SIC code industry groupings as specified by the ARB, for all of California and for each county in the State from 1970 to 1992, or the latest date for which data is available.

DRI prepared these data from the DRI Data Base, the world's largest private collection of economic, industry, and financial data, maintained on our mainframe computer in our Lexington, Massachusetts headquarters. DRI maintains thousands of data concepts at the State, MSA and county level for California, including the employment data from the BLS-790 survey data, the detailed ES 202 data for each county, and our enhanced County Business Patterns data base. The production or output data is collected only at the national level. To derive output by industry for each county, DRI combines the national data on ***output per employee*** available from the DRI Inter-industry Model and the Bureau of Economic Analysis (BEA) input/output table with employment by industry for each county The output per employee is recorded at the 432-industry level as described by the BEA's input/output classification scheme.

Data Prior to 1975

DRI currently maintains four-digit SIC employment data for California counties back to 1975, as reported by County Business Patterns. As part of this project effort, DRI collected the county employment data for the period 1970-74 in an effort to complete the data set. The major obstacle to this collection effort was the lack of usable data from the federal and state governments, even in printed form. The detailed ES-202 data that comprise the County Business Patterns data base are not kept on computer or tape prior to 1975 by the federal government. The printed documents are no longer published, and in fact are out of circulation. The only access to these documents is through official federal government document libraries.

The detailed employment data in County Business Patterns contain many suppressions, where employment levels are omitted to prevent disclosure of firm-specific information. DRI enhances the County Business Patterns data base to fill in these data suppressions, using information available at lower levels of detail, such as one- or two-digit SIC data and county totals, and statistical techniques. For the 1970-74 period, this enhancement was not possible. In addition, SIC code definitions were changed in 1972, further disrupting the continuity of the data.

As a result, the data collected for 1970-74 are best viewed as estimates of the size and distribution of employment by industry for each county.

The 1993 California Employment Revisions

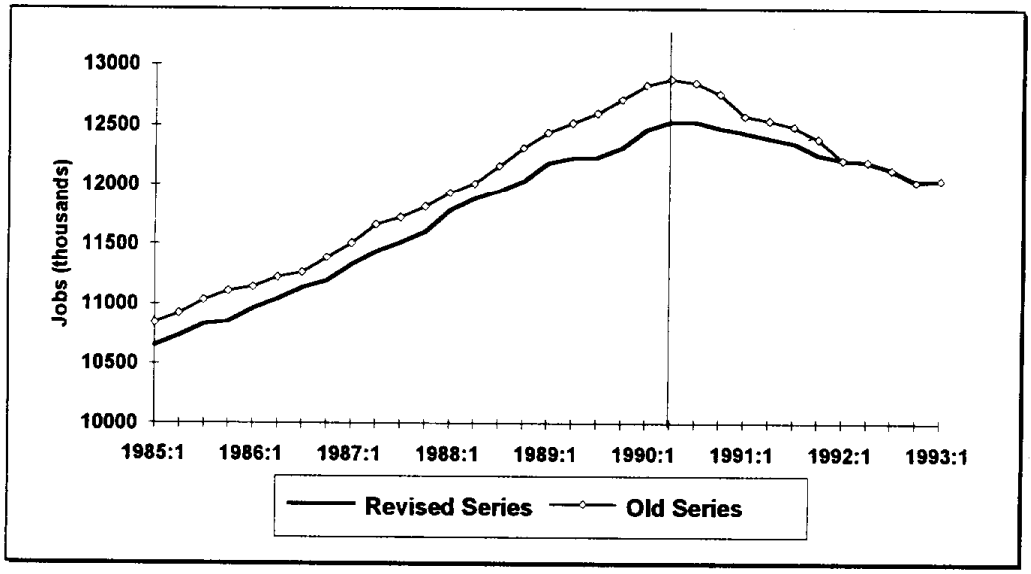
In June of 1993, the State of California released dramatically revised employment data for the period 1983 to 1992. The primary reason for the revision was a pervasive data collection problem during this period,

stemming from reporting errors embedded in payroll accounting software that was widely used across the state.

The size of the California revisions were surprising, particularly in a national context. Total California wage and salary employment in mid-1990, the pre-recession peak, was revised ***down*** by ***340,000*** jobs, or 3%. The result of these revisions are startling: according to these new data, California lost 500,000 jobs since 1990 rather than 850,000, or ***40% fewer*** than previously reported. The new and the old data are displayed in Chart 3.

Chart 3

Revised California Wage and Salary Job Figures



Average difference between old and revised series:

- 1985-88: 192,000 jobs
- 1989-90: 331,000 jobs
- 1991-92: 144,000 jobs

Do these data imply that the recession in California has been less severe than we thought? The answer is not clear.

DRI (and other observers) has concerns regarding three aspects of these revisions:

1. The size of the California revisions. The size of the revision for the entire United States in 1990 was 540,000 jobs. California's share of these revisions was 63%, yet the state's share of total jobs in the U.S. is 12%. A revision that is consistent with California's share of the U.S. economy would be between 100,00 and 125,000 jobs.
2. Other indicators have corroborated the deep recession in California depicted by the old employment data. In particular, income tax withholdings and sales tax receipts have

depicted a severe slump, and have moved very much in line with the job losses depicted by the old employment data.

3. The distribution of the revisions to industries and locations within California has resulted in growth patterns that are difficult to fully explain, particularly on a regional basis.

Regardless of these concerns, the data revisions are official and have been fully incorporated into the DRI analysis and forecasts. The next section describes how DRI has addressed these revisions at the MSA and county levels within California.

The MSA and County Revisions

DRI has determined that the statewide employment revisions have not been carried down to each county in a consistent fashion, and that the sum of the revised data across counties does equal the revised total for the state.

DRI has addressed this inconsistency in the compilation of the historical data, and the process is described below. DRI has chosen to abide by the official data released by the State of California under the Current Employment Survey, with our concerns and caveats made clear at the start.

The History

The primary reason for the data revisions was a pervasive data collection problem during the 1983-1992 period, stemming from reporting errors embedded in the payroll accounting software that was widely used across the state.

Following the statewide employment revisions, the California Employment Development Department (EDD) embarked on a revision of the employment data for the areas of the state covered by the Current Employment Survey (CES). The CES areas are the 17 largest Metropolitan Statistical Areas (MSAs) in California (out of a total of 23 MSAs statewide).

Table 3
CES Areas in California

Anaheim - Santa Ana
Bakersfield
Fresno
Los Angeles - Long Beach
Modesto
Oakland
Oxnard - Ventura
Riverside - San Bernardino
Sacramento
Salinas - Seaside - Monterey
San Diego
San Francisco
San Jose
Santa Barbara - Santa Maria - Lompoc
Santa Rosa - Petaluma
Stockton
Vallejo - Fairfield - Napa

At both the state and CES area levels, the revisions were made to the survey-based data, referred to as the 790 data. The EDD choose not to revise the problem data set directly, which are the payroll data, and are

referred to as the Employment Security data, or ES 202. The 790 data are the most current employment data available, and are released monthly with a 6 to 8 week lag. Each spring, the 790 data for the previous year are benchmarked to the ES 202 data, which are the universe of wage and salary employment, collected from employers' payroll records.

For the remainder of the state, the non-CES areas, a different unit of the EDD releases employment data that is similar in concept to the 790 series, but with several key differences. First, the CES is conducted by the EDD but funded by the federal government through the Bureau of Labor Statistics. The non-CES areas are funded by the EDD directly, which means much fewer resources are used to conduct surveys and analyze the data. Second, the BLS enforces strict rules for collecting and verifying the CES data, which are not required, and typically not followed in the non-CES areas. As a result, the employment data collected for the CES areas and the non-CES areas are not consistent, and there is no requirement that the totals for each type of area sum to the state total. ***In fact, they do not.***

When the EDD revised the state and then the CES-area data, there was no attempt made to revise or analyze the ***remainder*** for the non-CES areas of the state. When the non-CES areas were revised by a separate unit, the revisions were calculated without using the remainder from the CES calculations as a control total.

The result is that the sum of the revised CES and non-CES areas are much lower than the official state total. Looked at another way, the subtraction of the 17 CES areas' employment totals from the state total results in a remainder that is much larger than the revised non-CES data would indicate.

Looking at the pattern of these remainders versus the state and CES totals, DRI has concerns over the veracity of the revisions at each level. For example, in 1988, state employment grew 3.8%, but the 17 CES areas grew at a slower 3.5% rate. Subtracting the 17 areas from the state total, the revised data imply that the non-CES areas grew 9.0% in the same year. In 1991, the state lost jobs at 1.1% rate, the CES areas fell even faster at 1.4%, so the remainder ***grew 2.8%***. In 1992, while the state numbers fell another 1.8%, the CES areas fell 2.4%, requiring the remainder to ***increase 6.9%***.

DRI's analysis of the old data does indicate that the smaller MSAs and the non-MSA counties in California were starting to grow faster than the large MSAs in the late 1980s and into the early 1990s. The downsizing and significant layoffs in many industries have been concentrated in the large coastal MSAs, and the smaller areas of the state have been left untouched. DRI believes the size of the remainder is still too large to be fully explained by stronger growth in the non-CES portions of the state, and our resolution to these data issues is outlined in the next section.

The DRI Solution

DRI has not determined where the revisions might result in the suspicious remainder: we cannot tell if the state numbers are "too high", or the CES area numbers are "too low", or if the problems are the result of the revision process and methods. The state level revisions were performed with a focus on industry divisions, while the CES area revisions started with the new state numbers and focused on regional shares.

In order to comply with the official data released from the state, DRI has adopted the revised employment data for the state and for the 17 CES areas. Because our project requires data across areas within the state to sum to the state total, DRI has constrained the non-CES areas of the state to sum to the remainder left from the CES revisions. ***The result is that DRI has restated the employment data for the non-CES areas from 1983 to 1992, and the sum of all counties equals the state total.***

In our ongoing forecasting efforts for California and the regions within the state, DRI in the past has relied on the CES data from the state and the CES areas, and has constrained the ES 202 data for the non-CES areas to sum to the remainder. Therefore, DRI has successfully used the methodology adopted for this project on a regular basis. Prior to the CES revisions released in 1993, this methodology has proven to be very robust.

The restated historical data for the non-CES areas of the state does not materially affect the forecasts developed for this project. DRI estimates that the restated employment data for the non-CES counties are between 4% and 8% higher than the old (pre-revision) state and CES data would imply.

While DRI is cautious about the size of the remainder resulting from the 1993 revisions, we feel it is groundless to reject the official state and CES-area data without official data for the non-CES areas. The state has released employment data for the non-CES areas that have been revised using methodology similar to that employed for the CES areas, but without any requirement that the CES and non-CES areas sum to the state total. In addition, the revised non-CES data do not carry the sanction nor the official stature of the 790 CES data.

DRI has made every effort to develop a consistent, reliable data base for this project, and our solution is the best compromise that includes using as much official state data as possible.

Special Note on Agricultural Data

DRI collects and forecasts agricultural employment and output data at the state and national level, as reported in the Input/Output tables released by the BEA. To derive county-level output, DRI normally applies national output per worker values to employment levels in a particular industry. In the case of agricultural data for California counties (SICs 01, 02, and 07), this approach was deemed unsatisfactory, due to the unique nature of agricultural production in California.

Since the BEA does not release county-level agricultural data, DRI collected the annual *Gross Value of Agricultural Production* statistics for California. These data are reported by each County Agricultural Commissioner, and published by the California Agricultural Statistics Service, a unit of California Department of Food and Agriculture. These detailed data were aggregated to the appropriate "crops" and "livestock" definitions, as specified by the SIC Manual.

DRI also collected the detailed agricultural employment data for SICs 01, 02 and 07, made available by the California Employment Development Department. These data were particularly useful in filling gaps in employment reports available from the BEA.

The result of this additional data collection effort by DRI was a projection of employment and output for crops, livestock and agricultural services that is in complete accordance with the most current and accurate data on California's unique agriculture industry.

Special Notes on Other Data

Government

The BEA input/output classification for government employment includes all employees associated with federal, state and local government agencies, but the measurement of output is different from that of most goods- and services-producing industries. Real output per employee for the government sector is much lower than in most other sectors, for several very important reasons. First, a large amount of "output" that is directly attributable to government spending is actually captured by final demand. The best examples are transfer payments to individuals, such as welfare. Second, the BEA classifies government enterprise activity that is ***essentially similar*** to private sector activity under the category for the private sector. For example, federal government electricity generation is classified under "Electric Services", SIC 4911. Therefore, output directly attributed to the government sector is largely made up by "enterprise" activity, examples of which are government-owned and run local transportation services, including ports and airports, municipal utilities such as Sacramento Municipal Utility District (SMUD) and East Bay MUD, and the California Lottery.

Population

One set of data not included in the tables of detailed county projections are county population estimates. DRI derives population projections for each county as an integral component of the County Modeling System. Thus, the DRI county population figures are consistent with and are developed as part of our county employment projections. DRI's county population numbers are consistent with DRI's state population projections. The table presented in Volume I summarizes the county population projections developed as part of this forecasting project.

DRI's population projections for California and its counties differ from those prepared by the Demographic Research Unit of the California Department of Finance (Table 4).

Population is treated as an endogenous variable in the DRI Regional Modeling System, and the forecasts of population are entirely consistent with our assumptions and forecasts for the macro-economy, including employment gains and losses by sector and by region, and the larger economic forces that cause states and regions to compete with one another for jobs and economic activity. Population in the DRI Regional Model is guided by economic forces both from within California and from the rest of the nation and the world. As a result, the comprehensive restructuring of the California economy since 1990 has dramatically reduced the DRI forecast of population for the state.

Table 4
Comparison Of Population Projections For California

Level (Millions)	**1990**	**2000**	**2010**	**2020**
DRI	29.946	33.894	37.661	41.799
DoF	29.976	36.444	42.408	48.977
Avg. Ann. Growth	**1990-2000**	**2000-2010**	**2010-2020**	**1990-2020**
DRI	1.25%	1.06%	1.05%	1.12%
DoF	1.98%	1.53%	1.45%	1.65%
U.S. (DRI)	0.97%	0.82%	0.79%	0.86%

The population projections prepared by the Demographic Research Unit are developed using a demographic model that focuses on survival rates, fertility rates, and migration. Assumptions about these three factors are made for age groups, gender, and race/ethnicity, and the county-specific migration assumptions are adjusted to be consistent with statewide Department of Finance assumptions. (A complete description of the state methodology is available in the "Technical Notes" attached to the annual population projections published by the Demographic Research Unit). The demographic model employed by the Department of Finance is not linked to an economic model of the State of California.

The difference between the population projections prepared by DRI and the Department of Finance are brought into sharp focus by examining the underlying components of population growth, and the assumptions made by DRI and the DoF for the future of these components. Using their demographic model, the DoF assumes that net migration will average 226,000 for the next 50 years. This average includes a slowing of net migration from the peak of the late 1980s, when it reached 400,000, but the DoF assumes a rate that approaches 270,000 in the late 1990s. After the year 2000, the DoF expects migration to slowly decline from 230,000 to an annual average of 216,000 after the year 2010.

These net migration assumptions are significantly higher than those developed by DRI (Table 5). For the decade of the 1990s, DRI believes that net migration will be dramatically lower than during the past two decades. In fact, California will suffer negative net migration for several years between 1993 and 1997,

and DRI's assumptions for net migration after 2000 are significantly lower. Negative net migration was recorded in California during 1993, and the trend will worsen over the next few years before improving. People are still moving to the state, but many more are leaving. After the year 2000, much slower population growth at the national level, combined with the aging of the population will help curb the flow of new migrants to the state. California will still surpass the nation in population growth over the next three decades (Table 4).

Table 5
Components of DRI's Population Growth for California

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
(thousands)										
Pop. Growth	639.3	494.1	482.6	402.9	312.5	297.2	336.3	381.3	436.7	418.8
Births	609.9	588.8	643.3	737.7	649.6	676.8	720.9	694.4	647.3	615.6
Deaths	211.9	211.1	227	267.8	241.6	257.7	280.9	276.4	262.7	254.4
Net Migration	241.2	116.4	66.3	-67	-95.6	-121.9	-103.7	-36.7	52.1	57.6

	2000	2010	2020
Pop. Growth	385.7	403.7	429.1
Births	629.2	634.3	663.3
Deaths	264.4	287.1	321.2
Net Migration	20.9	56.5	87.0

The difference between the population projections from DRI and the DoF is particularly pronounced in Southern California, and stems largely from the difference between net migration assumptions. In the five-county L.A. basin, for example, DRI's population projection for the year 2020 is 19.366 million, 18.5% below the DoF projection. DRI projects significant growth in the basin, with gains over 1990 equal to 24% for Los Angeles county, 50% for San Bernardino, and 70% for Riverside. In contrast, the DoF predicts a 45% increase for Los Angeles, and a two-and-a-half times increase in population for San Bernardino and Riverside. DRI does not believe that underlying economic growth in the Southern California region will sustain such a high rate of population growth.

SIC Code Definitions

Several SIC codes specified by the ARB in the initial Request for Proposal could not be used to classify employment and output data. In each case, DRI has taken appropriate steps, with approval from ARB staff, to develop alternative classifications that best meet the needs of the ARB.

1. **SICs: 321 (flat glass), 322 (glass and glassware, pressed or blown), 323 (glass products from purchased glass).**

Action: combined into *two* categories. **321** = 3211 + 3229 + 3231 (glass products except containers), **322** = 3221 (glass containers).

Reason: direct fit with 432 BEA input/output classification.

2. **SIC: 4953 (refuse systems)**

Action: collected and forecast three-digit SIC 495.

Reason: no data available at any level (county, MSA, state, nation) for SIC 4953. California EDD does not collect data for this SIC code, and BEA reports it only through the roll-up of 4950 to 4959.

3. SIC: 7535 (auto paint shops)

Action: deleted.

Reason: 7535 now reported as part of 7532 (auto top, body & upholstery repair & paint shops).

Summary of Data Sources

DRI prepared the historical California state- and county-level data from the DRI Data Base, the world's largest private collection of economic, industry, and financial data, maintained on our mainframe computer in our Lexington, Massachusetts headquarters. DRI enhanced the data in our Data Base using a selection of primary data sources. A complete description of the data collection effort is described above. A summary listing of the sources for all data used in this study is outlined below.

Employment

Non-agricultural employment:

DRI "@MARKETS" Data Base
BLS-790 2-digit SIC for state totals, 17 CES-designated Metropolitan Statistical Areas.

DRI "Enhanced County Business Patterns" Data Base
ES-202 4-digit SIC for every county.

California Employment Development Department
BLS-790 revisions for state totals, 17 CES-designated Metropolitan Statistical Areas.

Agricultural employment:

DRI "Enhanced County Business Patterns" Data Base
ES-202 2-digit for SICs 01,02, and 07 for every county.

California Employment Development Department
Supplemental ES-202 2-digit for SICs 01,02, and 07 for every county.

Population

Resident Population:

DRI "@MARKETS" Data Base
Current Population Reports P25, US Bureau of the Census for every county.

Output

Output:

DRI "Inter-Industry Model" Data Base
Output and output per employee based on the Bureau of Economic Analysis (BEA) Input-Output table and survey, updated and enhanced by DRI. See Appendix 6 for a complete description of the DRI Inter-Industry Model.

Appendix 1.
Standard Industrial Classification Codes

SIC Code	Sector Name	DRI Industry Number

SIC codes are listed as 1977 definitions, in order to match the 1977 Input/Output classifications. The data are collected at the 1987 definitions, translated to 1977 for use in the model, and translated back to 1987 definitions for reporting.

111	WHEAT	5
112	RICE	5
115	CORN	6
116	SOYBEANS	5
119	CASH GRAINS, NEC	6
131	COTTON	4
132	TOBACCO	7
134	IRISH POTATOES	9
139	FIELD CROPS, NEC	10
161	VEGETABLES	9
171	BERRY CROPS	8
172	GRAPES	8
173	TREE NUTS	8
174	CITRUS FRUITS	8
175	DECIDUOUS TREE FRUITS	8
179	FRUITS & TREE NUTS, NEC	8
181	NURSERY & ORNAMENTAL	10
182	FOOD CROPS GROWN UNDER COVER	10
191	GENERAL FARMS, PRIMARILY CROPS	10
211	BEEF CATTLE FEEDLOTS	3
212	BEEF CATTLE, EXCEPT FEEDLOTS	3
213	HOGS	3
214	SHEEP & GOATS	3
219	GENERAL LIVESTOCK, EX. DAIRY & POULTRY	3
241	DAIRY FARMS	1
251	BROILER, FRYER & ROASTER CHICKENS	2
252	CHICKEN EGGS	2
253	TURKEYS & TURKEY EGGS	2
254	POULTRY HATCHERIES	14
259	POULTRY & EGGS, NEC	2
271	FUR BEARING ANIMALS & RABBITS	3
272	HORSES	3
279	ANIMAL SPECIALTIES, NEC	3
711	SOIL PREPARATION SERVICES	14
721	CROP PLANTING	14
741	VETERINARY SERVICES	423
761	LIVESTOCK SERVICES	14
762	FARM LABOR CONTRACTORS	14
781	FARM MANAGEMENT SERVICES	14
811	TIMBER TRACTS	12
912	FIN FISH	13
913	SHELLFISH	13
919	MISC MARINE PRODUCTS	13
921	FISH HATCHERIES	14
971	HUNTING & TRAPPING	12
1011	IRON ORES	15
1021	COPPER ORES	16
1031	LEAD AND ZINC ORES	17
1041	GOLD ORES	17

SIC Code	Sector Name	DRI Industry Number
1044	SILVER ORES	17
1049	GOLD AND SILVER ORES REMAINDER	17
1051	BAUXITE AND OTHER ALUMINUM ORES	17
1061	FERROALLOY ORES, EXCEPT VANADIUM	15
1081	METAL MINING SERVICES	17
1092	MERCURY ORES	17
1094	URANIUM-RADIUM-VANADIUM ORES	17
1099	METAL MINING REMAINDER	17
1111	ANTHRACITE	18
1112	ANTHRACITE MINING SERVICES	18
1199	ANTHRACITE MINING SERVICES REMAINDER	18
1211	BITUMINOUS COAL AND LIGNITE	18
1213	BITUMINOUS LIGNITE MINING SERVICES	18
1219	BITUMINOUS COAL AND LIGNITE MINING REMAINDER	18
1299	BITUMINOUS COAL AND LIGNITE MINING REMAINDER	18
1311	CRUDE PETROLEUM AND NATURAL GAS	19
1321	NATURAL GAS LIQUIDS	20
1381	DRILLING OIL AND GAS WELLS	19
1382	OIL AND GAS EXPLORATION SERVICES	20
1389	OIL AND GAS FIELD SERVICES REMAINDER	19
1399	OIL AND GAS EXTRACTION REMAINDER	19
1411	DIMENSION STONE	21
1422	CRUSHED AND BROKEN LIMESTONE	21
1423	CRUSHED AND BROKEN GRANITE	21
1429	CRUSHED AND BROKEN STONE REMAINDER	21
1442	CONSTRUCTION SAND AND GRAVEL	21
1446	INDUSTRIAL SAND	21
1449	SAND AND GRAVEL REMAINDER	21
1452	BENTONITE	21
1453	FIRE CLAY	21
1454	FULLER'S EARTH	21
1455	KAOLIN AND BALL CLAY	21
1459	CLAY AND RELATED MINERALS REMAINDER	21
1472	BARITE	22
1473	FLUORSPAR	22
1474	POTASH, SODA, AND BORATE MINERALS	22
1475	PHOSPHATE ROCK	22
1476	ROCK SALT	22
1477	SULFUR	22
1479	CHEMICAL AND FERTILIZER MINERALS REMAINDER	22
1481	NONMETALLIC MINERALS SERVICES	21
1492	GYPSUM	21
1496	TALC, SOAPSTONE, AND PYROPHYLLITE	21
1499	NONMETALLIC MINERALS, EXCEPT FUELS REMAINDER	21
1521	ONE-FAMILY HOUSING	23
1522	RES CONSTRUCTTION	23
1531	OPERATIVE BUILDERS	398
1541	INDUS BLDGS & WAREHOUSES	23
1542	MISC NONRES CONSTRUC	23
1611	HGWY & STREET CONSTRUC	23
1622	BRIDGES & TUNNELS	33
1623	WATER SEWER & UTILITY	33
1629	MISC HEAVY CONSTRUCTION	33
1711	PLUMBING, HEATING, & AIR	28

SIC Code	Sector Name	DRI Industry Number
1721	PAINTING & DECORATING	28
1731	ELECTRICAL WORK	28
1741	MASONRY & OTHER STONEWK	28
1742	PLASTERING & INSULATION	28
1743	TILE, MARBLE & MOSAIC WK	28
1751	CARPENTERING	28
1752	MISC FLOOR WORK	28
1761	ROOFING SHEET METAL WK	28
1771	CONCRETE WORK	28
1781	WATER WELL DRILLING	28
1791	STRUC STEEL ERECTION	28
1793	GLASS GLAZING WORK	28
1794	EXCAVATING & FOUNDATION WK	28
1795	WRECKING DEMOLITION WK	28
1796	INSTALLATION OF BLDG EQUIP	28
1799	SPEC TRADE CONTRACTORS	28
2011	MEAT PACKING PLANTS	56
2013	SAUSAGES AND OTHER PREPARED MEATS	57
2016	POULTRY DRESSING PLANTS	58
2017	POULTRY AND EGG PROCESSING	59
2019	MEAT PRODUCTS REMAINDER	99
2021	CREAMERY BUTTER	60
2022	CHEESE, NATURAL AND PROCESSED	61
2023	CONDENSED AND EVAPORATED MILK	62
2024	ICE CREAM AND FROZEN DESSERTS	63
2026	FLUID MILK	64
2029	DAIRY PRODUCTS REMAINDER	99
2032	CANNED SPECIALTIES	66
2033	CANNED FRUITS AND VEGETABLES	67
2034	DEHYDRATED FRUITS, VEGETABLES, SOUPS	68
2035	PICKLES, SAUCES, AND SALAD DRESSINGS	69
2037	FROZEN FRUITS AND VEGETABLES	71
2038	FROZEN SPECIALTIES	71
2039	PRESERVED FRUITS AND VEGETABLES REMAINDER	99
2041	FLOUR AND OTHER GRAIN MILL PRODUCTS	72
2043	CEREAL BREAKFAST FOODS	73
2044	RICE MILLING	77
2045	BLENDED AND PREPARED FLOUR	74
2046	WET CORN MILLING	78
2047	DOG, CAT, AND OTHER PET FOOD	75
2048	PREPARED FEEDS, NEC	76
2049	GRAIN MILL PRODUCTS REMAINDER	76
2051	BREAD, CAKE, AND RELATED PRODUCTS	79
2052	COOKIES AND CRACKERS	80
2059	BAKERY PRODUCTS REMAINDER	99
2061	RAW CANE SUGAR	81
2062	CANE SUGAR REFINING	81
2063	BEET SUGAR	81
2065	CONFECTIONERY PRODUCTS	82
2066	CHOCOLATE AND COCOA PRODUCTS	83
2067	CHEWING GUM	84
2069	SUGAR AND CONFECTIONERY PRODUCTS REMAINDER	99
2074	COTTONSEED OIL MILLS	91
2075	SOYBEAN OIL MILLS	92

SIC Code	Sector Name	DRI Industry Number
2076	VEGETABLE OIL MILLS, NEC	93
2077	ANIMAL AND MARINE FATS AND OILS	94
2079	FATS AND OILS REMAINDER	96
2082	MALT BEVERAGES	85
2083	MALT	86
2084	WINES, BRANDY, AND BRANDY SPIRITS	87
2085	DISTILLED LIQUOR, EXCEPT BRANDY	88
2086	BOTTLED AND CANNED SOFT DRINKS	89
2087	FLAVORING EXTRACTS AND SIRUPS, NEC	90
2089	BEVERAGES REMAINDER	99
2091	CANNED AND CURED SEAFOODS	65
2092	FRESH OR FROZEN PACKAGED FISH	70
2095	ROASTED COFFEE	95
2097	MANUFACTURED ICE	97
2098	MACARONI AND SPAGHETTI	98
2099	FOOD AND KINDRED PRODUCTS REMAINDER	99
2111	CIGARETTES	100
2121	CIGARS	101
2131	CHEWING AND SMOKING TOBACCO	102
2141	TOBACCO STEMMING AND REDRYING	103
2199	TOBACCO MANUFACTURES REMAINDER	103
2211	WEAVING MILLS, COTTON	104
2221	WEAVING MILLS, SYNTHETICS	104
2231	WEAVING AND FINISHING MILLS, WOOL	104
2241	NARROW FABRIC MILLS	105
2251	WOMEN'S HOSIERY, EXCEPT SOCKS	112
2252	HOSIERY, NEC	112
2253	KNIT OUTERWEAR MILLS	112
2254	KNIT UNDERWEAR MILLS	112
2257	CIRCULAR KNIT FABRIC MILLS	113
2258	WARP KNIT FABRIC MILLS	113
2259	KNITTING MILLS REMAINDER	112
2261	FINISHING PLANTS, COTTON	104
2262	FINISHING PLANTS, SYNTHETICS	104
2269	TEXTILE FINISHING, EXCEPT WOOL REMAINDER	106
2271	WOVEN CARPETS AND RUGS	108
2272	TUFTED CARPETS AND RUGS	108
2279	FLOOR COVERING MILLS REMAINDER	108
2281	YARN MILLS, EXCEPT WOOL	106
2282	THROWING AND WINDING MILLS	106
2283	WOOL YARN MILLS	106
2284	THREAD MILLS	107
2289	YARN AND THREAD MILLS REMAINDER	111
2291	FELT GOODS, EXC. WOVEN FELTS HATS	109
2292	LACE GOODS	109
2293	PADDINGS AND UPHOLSTERY FILLING	109
2294	PROCESSED TEXTILE WASTE	109
2295	COATED FABRICS, NOT RUBBERIZED	110
2296	TIRE CORD AND FABRIC	111
2297	NONWOVEN FABRICS	111
2298	CORDAGE AND TWINE	111
2299	TEXTILE MILL PRODUCTS REMAINDER	114
2311	MEN'S AND BOYS' SUITS AND COATS	114
2321	MEN'S AND BOYS' SHIRTS AND NIGHTWEAR	

SIC Code	Sector Name	DRI Industry Number
2322	MEN'S AND BOYS' UNDERWEAR	114
2323	MEN'S AND BOYS' NECKWEAR	114
2327	MEN'S AND BOYS' SEPARATE TROUSERS	114
2328	MEN'S AND BOYS' WORK CLOTHING	114
2329	MEN'S AND BOYS' FURNISHINGS REMAINDER	114
2331	WOMEN'S MISSES' BLOUSES WAISTS	114
2335	WOMEN'S AND MISSES' DRESSES	114
2337	WOMEN'S AND MISSES' SUITS AND COATS	114
2339	WOMEN'S AND MISSES' OUTERWEAR REMAINDER	114
2341	WOMEN'S AND CHILDREN'S UNDERWEAR	114
2342	BRASSIERES AND ALLIED GARMENTS	114
2349	WOMEN'S AND CHILDREN'S UNDERGARMENTS REMAINDER	114
2351	MILLINERY	114
2352	HATS AND CAPS, EXCEPT MILLINERY	114
2359	HATS, CAPS, AND MILLINERY REMAINDER	114
2361	CHILDREN'S DRESSES AND BLOUSES	114
2363	CHILDREN'S COATS AND SUITS	114
2369	CHILDREN'S OUTERWEAR REMAINDER	114
2371	FUR GOODS	114
2381	FABRIC DRESS AND WORK GLOVES	114
2384	ROBES AND DRESSING GOWNS	114
2385	WATERPROOF OUTERGARMENTS	114
2386	LEATHER AND SHEEP LINED CLOTHING	114
2387	APPAREL BELTS	114
2389	MISCELLANEOUS APPAREL AND ACCESSORIES REMAINDER	114
2391	CURTAINS AND DRAPERIES	115
2392	HOUSE FURNISHINGS, NEC	115
2393	TEXTILE BAGS	116
2394	CANVAS AND RELATED PRODUCTS	116
2395	PLEATING AND STITCHING	116
2396	AUTOMOTIVE AND APPAREL TRIMMINGS	116
2397	SCHIFFI MACHINE EMBROIDERIES	116
2399	APPAREL AND OTHER TEXTILE PRODUCTS REMAINDER	116
2411	LOGGING CAMPS LOGGING CONTRACTORS	117
2421	SAWMILLS AND PLANING MILLS, GENERAL	118
2426	HARDWOOD DIMENSION AND FLOORING	119
2429	SAWMILLS AND PLANING MILLS REMAINDER	120
2431	MILLWORK	121
2434	WOOD KITCHEN CABINETS	122
2435	HARDWOOD VENEER AND PLYWOOD	123
2436	SOFTWOOD VENEER AND PLYWOOD	123
2439	MILLWORK, PLYWOOD STRUCTURAL MEMBERS REMAINDER	124
2441	NAILED WOOD BOXES AND SHOOK	130
2448	WOOD PALLETS AND SKIDS	127
2449	WOOD CONTAINERS REMAINDER	130
2451	MOBILE HOMES	359
2452	PREFABRICATED WOOD BUILDINGS	125
2491	WOOD PRESERVING	126
2492	PARTICLEBOARD	128
2499	LUMBER AND WOOD PRODUCTS REMAINDER	129
2511	WOOD HOUSEHOLD FURNITURE	131
2512	UPHOLSTERED HOUSEHOLD FURNITURE	134
2514	METAL HOUSEHOLD FURNITURE	135
2515	MATTRESSES AND BEDSPRINGS	136

SIC Code	Sector Name	DRI Industry Number
2517	WOOD TV AND RADIO CABINETS	133
2519	HOUSEHOLD FURNITURE REMAINDER	132
2521	WOOD OFFICE FURNITURE	137
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5133	PIECE GOODS	392
5134	NOTIONS AND OTHER DRY GOODS	392
5136	MEN'S CLOTHING AND FURNISHINGS	392
5137	WOMEN'S AND CHILDREN'S CLOTHING	392
5139	APPAREL, PIECE GOODS, AND NOTIONS REMAINDER	392
5141	GROCERIES, GENERAL LINE	392
5142	FROZEN FOODS	392
5143	DAIRY PRODUCTS	392
5144	POULTRY AND POULTRY PRODUCTS	392
5145	CONFECTIONERY	392
5146	FISH AND SEAFOODS	392
5147	MEATS AND MEAT PRODUCTS	392
5148	FRESH FRUITS AND VEGETABLES	392
5149	GROCERIES AND RELATED PRODUCTS REMAINDER	392
5152	COTTON	392
5153	GRAIN	392
5154	LIVESTOCK	392
5159	FARM-PRODUCT RAW MATERIALS REMAINDER	392
5161	CHEMICALS AND ALLIED PRODUCTS	392
5171	PETROLEUM BULK STATIONS TERMINALS	392
5172	PETROLEUM PRODUCTS, NEC	392
5179	PETROLEUM AND PETROLEUM PRODUCTS REMAINDER	392
5181	BEER AND ALE	392
5182	WINES AND DISTILLED BEVERAGES	392
5189	BEER, WINE, AND DISTILLED BEVERAGES REMAINDER	392
5191	FARM SUPPLIES	392

SIC Code	Sector Name	DRI Industry Number
5194	TOBACCO AND TOBACCO PRODUCTS	392
5198	PAINTS, VARNISHES, AND SUPPLIES	392
5199	WHOLESALE TRADE-NONDURABLE GOODS REMAINDER	392
5211	LUMBER AND OTHER BUILDING MATERIALS	393
5231	PAINT, GLASS, AND WALLPAPER STORES	393
5251	HARDWARE STORES	393
5261	RETAIL NURSERIES AND GARDEN STORES	393
5271	MOBILE HOME DEALERS	393
5299	BUILDING MATERIALS GARDEN SUPPLIES REMAINDER	393
5311	DEPARTMENT STORES	393
5331	VARIETY STORES	393
5391	MISC. GENERAL MERCHANDISE STORES	393
5399	GENERAL MERCHANDISE STORES REMAINDER	393
5411	GROCERY STORES	393
5422	FREEZER AND LOCKER MEAT PROVISIONERS	393
5423	MEAT AND FISH (SEAFOOD) MARKETS	393
5429	MEAT MARKETS AND FREEZER PROVISIONERS REMAINDER	393
5431	FRUIT STORES AND VEGETABLE MARKETS	393
5441	CANDY, NUT, AND CONFECTIONERY STORES	393
5451	DAIRY PRODUCTS STORES	393
5461	RETAIL BAKERIES	393
5491	MISCELLANEOUS FOOD STORES	393
5499	FOOD STORES REMAINDER	393
5511	NEW AND USED CAR DEALERS	393
5521	USED CAR DEALERS	393
5531	AUTO AND HOME SUPPLY STORES	393
5541	GASOLINE SERVICE STATIONS	393
5551	BOAT DEALERS	393
5561	RECREATION UTILITY TRAILER DEALERS	393
5571	MOTORCYCLE DEALERS	393
5591	AUTOMOTIVE DEALERS, NEC	393
5599	AUTOMOTIVE DEALERS SERVICE STATIONS REMAINDER	393
5611	MEN'S BOYS' CLOTHING FURNISHINGS	393
5621	WOMEN'S READY-TO-WEAR STORES	393
5631	WOMEN'S ACCESSORY AND SPECIALTY STORES	393
5641	CHILDREN'S AND INFANTS' WEAR STORES	393
5651	FAMILY CLOTHING STORES	393
5661	SHOE STORES	393
5681	FURRIERS AND FUR SHOPS	393
5691	MISCELLANEOUS APPAREL ACCESSORIES	393
5699	APPAREL AND ACCESSORY STORES REMAINDER	393
5712	FURNITURE STORES	393
5713	FLOOR COVERING STORES	393
5714	DRAPERY AND UPHOLSTERY STORES	393
5719	FURNITURE AND HOME FURNISHINGS STORES REMAINDER	393
5721	HOUSEHOLD APPLIANCE STORES	393
5732	RADIO AND TELEVISION STORES	393
5733	MUSIC STORES	393
5739	RADIO, TELEVISION, AND MUSIC STORES REMAINDER	393
5799	FURNITURE AND HOME FURNISHINGS STORES REMAINDER	393
5812	EATING PLACES	415
5813	DRINKING PLACES	415
5819	EATING AND DRINKING PLACES REMAINDER	415
5899	EATING AND DRINKING PLACES REMAINDER	415

SIC Code	Sector Name	DRI Industry Number
5911	DRUG STORES AND PROPRIETARY STORES	393
5921	LIQUOR STORES	393
5931	USED MERCHANDISE STORES	393
5941	SPORTING GOODS AND BICYCLE SHOPS	393
5942	BOOK STORES	393
5943	STATIONERY STORES	393
5944	JEWELRY STORES	393
5945	HOBBY, TOY, AND GAME SHOPS	393
5946	CAMERA PHOTOGRAPHIC SUPPLY STORES	393
5947	GIFT, NOVELTY, AND SOUVENIR SHOPS	393
5948	LUGGAGE AND LEATHER GOODS STORES	393
5949	MISCELLANEOUS SHOPPING GOODS STORES REMAINDER	393
5961	MAIL ORDER HOUSES	393
5962	MERCHANDISING MACHINE OPERATORS	393
5963	DIRECT SELLING ORGANIZATIONS	393
5969	NONSTORE RETAILERS REMAINDER	393
5982	FUEL AND ICE DEALERS, NEC	393
5983	FUEL OIL DEALERS	393
5984	LIQUEFIED PETROLEUM GAS DEALERS	393
5989	FUEL AND ICE DEALERS REMAINDER	393
5992	FLORISTS	393
5993	CIGAR STORES AND STANDS	393
5994	NEWS DEALERS AND NEWSSTANDS	393
5999	MISCELLANEOUS RETAIL REMAINDER	393
6011	FEDERAL RESERVE BANKS	394
6021	COMMERCIAL AND STOCK SAVINGS BANKS	394
6031	MUTUAL SAVINGS BANKS	394
6041	TRUST COMPANIES, NONDEPOSIT	394
6051	FUNCTIONS CLOSELY RELATED TO BANKING	394
6099	BANKING REMAINDER	394
6112	REDISCOUNTING, NOT FOR AGRICULTURAL	395
6119	REDISCOUNT AND FINANCING INSTITUTIONS REMAINDER	395
6121	SAVINGS AND LOAN ASSOCIATIONS	395
6131	AGRICULTURAL CREDIT INSTITUTIONS	395
6141	PERSONAL CREDIT INSTITUTIONS	395
6151	BUSINESS CREDIT INSTITUTIONS	395
6161	MORTGAGE BANKERS AND BROKERS	395
6199	CREDIT AGENCIES OTHER THAN BANKS REMAINDER	395
6211	SECURITY BROKERS AND DEALERS	395
6221	COMMODITY CONTRACTS BROKERS, DEALERS	395
6231	SECURITY AND COMMODITY EXCHANGES	395
6281	SECURITY AND COMMODITY SERVICES	395
6299	SECURITY, COMMODITY BROKERS SERVICES REMAINDER	395
6311	LIFE INSURANCE	396
6321	ACCIDENT AND HEALTH INSURANCE	396
6324	HOSPITAL AND MEDICAL SERVICE PLANS	396
6329	MEDICAL SERVICE AND HEALTH INSURANCE REMAINDER	396
6331	FIRE, MARINE, AND CASUALTY INSURANCE	396
6351	SURETY INSURANCE	396
6361	TITLE INSURANCE	396
6371	PENSION, HEALTH, AND WELFARE FUNDS	396
6391	INSURANCE CARRIERS, NEC	396
6399	INSURANCE CARRIERS REMAINDER	396
6411	INSURANCE AGENTS, BROKERS SERVICE	396

SIC Code	Sector Name	DRI Industry Number
6499	INSURANCE AGENTS, BROKERS SERVICE REMAINDER	396
6511	REAL ESTATE OPERATORS AND LESSORS	398
6531	REAL ESTATE AGENTS AND MANAGERS	398
6541	TITLE ABSTRACT OFFICES	398
6552	SUBDIVIDERS AND DEVELOPERS, NEC	398
6553	CEMETERY SUBDIVIDERS AND DEVELOPERS	398
6559	SUBDIVIDERS AND DEVELOPERS REMAINDER	398
6599	REAL ESTATE REMAINDER	398
6611	COMBINED REAL ESTATE, INSURANCE, ETC	398
6699	COMBINED REAL ESTATE, INSURANCE, ETC REMAINDER	398
6711	HOLDING OFFICES	395
6721	INVESTMENT OFFICES	395
6732	EDUCATIONAL, RELIGIOUS, ETC. TRUSTS	395
6733	TRUSTS, NEC	395
6739	TRUSTS REMAINDER	395
6794	PATENT OWNERS AND LESSORS	395
6798	MORTGAGE-REALTY TRUST, REITS	395
6799	HOLDING AND OTHER INVESTMENT OFFICES REMAINDER	395
7011	HOTELS, MOTELS, AND TOURIST COURTS	399
7021	ROOMING AND BOARDING HOUSES	399
7032	SPORTING AND RECREATIONAL CAMPS	399
7033	TRAILERING PARKS FOR TRANSIENTS	399
7039	CAMPS AND TRAILERING PARKS REMAINDER	399
7041	MEMBERSHIP-BASIS ORGANIZATION HOTELS	399
7099	HOTELS AND OTHER LODGING PLACES REMAINDER	399
7211	POWER LAUNDRIES, FAMILY COMMERCIAL	400
7212	GARMENT PRESSING CLEANERS' AGENTS	400
7213	LINEN SUPPLY	400
7214	DIAPER SERVICE	400
7215	COIN-OPERATED LAUNDRIES AND CLEANING	400
7216	DRY CLEANING PLANTS, EXCEPT RUG	400
7217	CARPET AND UPHOLSTERY CLEANING	400
7218	INDUSTRIAL LAUNDERERS	400
7219	LAUNDRY, CLEANING, GARMENT SERVICES REMAINDER	400
7221	PHOTOGRAPHIC STUDIOS, PORTRAIT	400
7231	BEAUTY SHOPS	401
7241	BARBER SHOPS	401
7251	SHOE REPAIR AND HAT CLEANING SHOPS	400
7261	FUNERAL SERVICE AND CREMATORIES	400
7291	MISCELLANEOUS PERSONAL SERVICES	400
7299	PERSONAL SERVICES REMAINDER	400
7311	ADVERTISING AGENCIES	407
7312	OUTDOOR ADVERTISING SERVICES	411
7313	RADIO, TV, PUBLISHER REPRESENTATIVES	407
7319	ADVERTISING REMAINDER	411
7321	CREDIT REPORTING AND COLLECTION	406
7331	DIRECT MAIL ADVERTISING SERVICES	406
7332	BLUEPRINTING AND PHOTOCOPYING	406
7333	COMMERCIAL PHOTOGRAPHY AND ART	406
7339	MAILING, REPRODUCTION, STENOGRAPHIC REMAINDER	406
7341	WINDOW CLEANING	406
7342	DISINFECTING AND EXTERMINATING	406
7349	SERVICES TO BUILDINGS REMAINDER	406
7351	NEWS SYNDICATES	406

SIC Code	Sector Name	DRI Industry Number
7361	EMPLOYMENT AGENCIES	402
7362	TEMPORARY HELP SUPPLY SERVICES	402
7369	PERSONNEL SUPPLY SERVICES REMAINDER	402
7372	COMPUTER PROGRAMMING AND SOFTWARE	403
7374	DATA PROCESSING SERVICES	403
7379	COMPUTER AND DATA PROCESSING SERVICES REMAINDER	403
7391	RESEARCH DEVELOPMENT LABORATORIES	404
7392	MANAGEMENT AND PUBLIC RELATIONS	404
7393	DETECTIVE AND PROTECTIVE SERVICES	406
7394	EQUIPMENT RENTAL AND LEASING	405
7395	PHOTOFINISHING LABORATORIES	406
7396	TRADING STAMP SERVICES	393
7397	COMMERCIAL TESTING LABORATORIES	404
7399	BUSINESS SERVICES REMAINDER	406
7512	PASSENGER CAR RENTAL AND LEASING	416
7513	TRUCK RENTAL AND LEASING	416
7519	AUTOMOTIVE RENTALS, WITHOUT DRIVERS REMAINDER	416
7523	PARKING LOTS	415
7525	PARKING STRUCTURES	417
7529	AUTOMOBILE PARKING REMAINDER	417
7531	TOP AND BODY REPAIR SHOPS	417
7534	TIRE RETREADING AND REPAIR SHOPS	417
7535	PAINT SHOPS	417
7538	GENERAL AUTOMOTIVE REPAIR SHOPS	417
7539	AUTOMOTIVE REPAIR SHOPS REMAINDER	417
7542	CAR WASHES	417
7549	AUTOMOTIVE SERVICES, EXCEPT REPAIR REMAINDER	417
7599	AUTO REPAIR, SERVICES, AND GARAGES REMAINDER	417
7622	RADIO AND TELEVISION REPAIR	400
7623	REFRIGERATION SERVICE AND REPAIR	400
7629	ELECTRICAL REPAIR SHOPS REMAINDER	400
7631	WATCH, CLOCK, AND JEWELRY REPAIR	400
7641	REUPHOLSTERY AND FURNITURE REPAIR	400
7692	WELDING REPAIR	406
7694	ARMATURE REWINDING SHOPS	406
7699	MISCELLANEOUS REPAIR SERVICES REMAINDER	406
7813	MOTION PICTURE PRODUCTION, EXCEPT TV	418
7814	MOTION PICTURE PRODUCTION FOR TV	418
7819	MOTION PICTURE PRODUCTION SERVICES REMAINDER	418
7823	MOTION PICTURE FILM EXCHANGES	418
7824	FILM OR TAPE DISTRIBUTION FOR TV	418
7829	MOTION PICTURE DISTRIBUTION AND SERVICES REMAINDER	418
7832	MOTION PICTURE THEATERS, EX DRIVE-IN	418
7833	DRIVE-IN MOTION PICTURE THEATERS	418
7839	MOTION PICTURE THEATERS REMAINDER	418
7899	MOTION PICTURES REMAINDER	418
7911	DANCE HALLS, STUDIOS, AND SCHOOLS	419
7922	THEATRICAL PRODUCERS AND SERVICES	419
7929	PRODUCERS, ORCHESTRAS, ENTERTAINERS REMAINDER	419
7932	BILLIARD AND POOL ESTABLISHMENTS	419
7933	BOWLING ALLEYS	419
7939	BOWLING AND BILLIARD ESTABLISHMENTS REMAINDER	419
7941	SPORTS CLUBS AND PROMOTERS	419
7948	RACING, INCLUDING TRACK OPERATION	419

SIC Code	Sector Name	DRI Industry Number
7949	COMMERCIAL SPORTS REMAINDER	419
7992	PUBLIC GOLF COURSES	419
7993	COIN-OPERATED AMUSEMENT DEVICES	419
7996	AMUSEMENT PARKS	419
7997	MEMBERSHIP SPORTS RECREATION CLUBS	419
7999	AMUSEMENT RECREATION SERVICES REMAINDER	419
8011	OFFICES OF PHYSICIANS	420
8021	OFFICES OF DENTIST5	420
8031	OFFICES OF OSTEOPATHIC PHYSICIANS	420
8041	OFFICES OF CHIROPRACTORS	420
8042	OFFICES OF OPTOMETRISTS	393
8049	OFFICES OF OTHER HEALTH PRACTITIONERS REMAINDER	423
8051	NURSING AND PERSONAL CARE FACILITIES	422
8061	HOSPITALS	421
8071	MEDICAL LABORATORIES	423
8072	DENTAL LABORATORIES	423
8079	MEDICAL AND DENTAL LABORATORIES REMAINDER	423
8081	OUTPATIENT CARE FACILITIES	423
8091	HEALTH AND ALLIED SERVICES, NEC	423
8099	HEALTH SERVICES REMAINDER	423
8111	LEGAL SERVICES	412
8199	LEGAL SERVICES REMAINDER	412
8211	ELEMENTARY AND SECONDARY SCHOOLS	424
8221	COLLEGES AND UNIVERSITIES	424
8231	LIBRARIES AND INFORMATION CENTERS	424
8241	CORRESPONDENCE SCHOOLS	424
8249	CORRESPONDENCE AND VOCATIONAL SCHOOLS REMAINDER	424
8291	SCHOOLS EDUCATIONAL SERVICES, NEC	424
8299	EDUCATIONAL SERVICES REMAINDER	424
8311	SOCIAL SERVICES, NEC	426
8361	RESIDENTIAL CARE	426
8369	RESIDENTIAL CARE REMAINDER	426
8411	MUSEUMS AND ART GALLERIES	425
8421	BOTANICAL AND ZOOLOGICAL GARDENS	425
8499	MUSEUMS, BOTANICAL, ZOOLOGICAL GARDENS REMAINDER	425
8611	BUSINESS ASSOCIATIONS	425
8621	PROFESSIONAL ORGANIZATIONS	425
8631	LABOR ORGANIZATIONS	425
8641	CIVIC AND SOCIAL ASSOCIATIONS	425
8651	POLITICAL ORGANIZATIONS	425
8661	RELIGIOUS ORGANIZATIONS	425
8691	MEMBERSHIP ORGANIZATIONS, NEC	425
8699	MEMBERSHIP ORGANIZATIONS REMAINDER	425
8911	ENGINEERING ARCHITECTURAL SERVICES	413
8921	NONCOMMERCIAL RESEARCH ORGANIZATIONS	425
8931	ACCOUNTING, AUDITING BOOKKEEPING	414
8991	SERVICES, NEC	414
8999	MISCELLANEOUS SERVICES REMAINDER	414

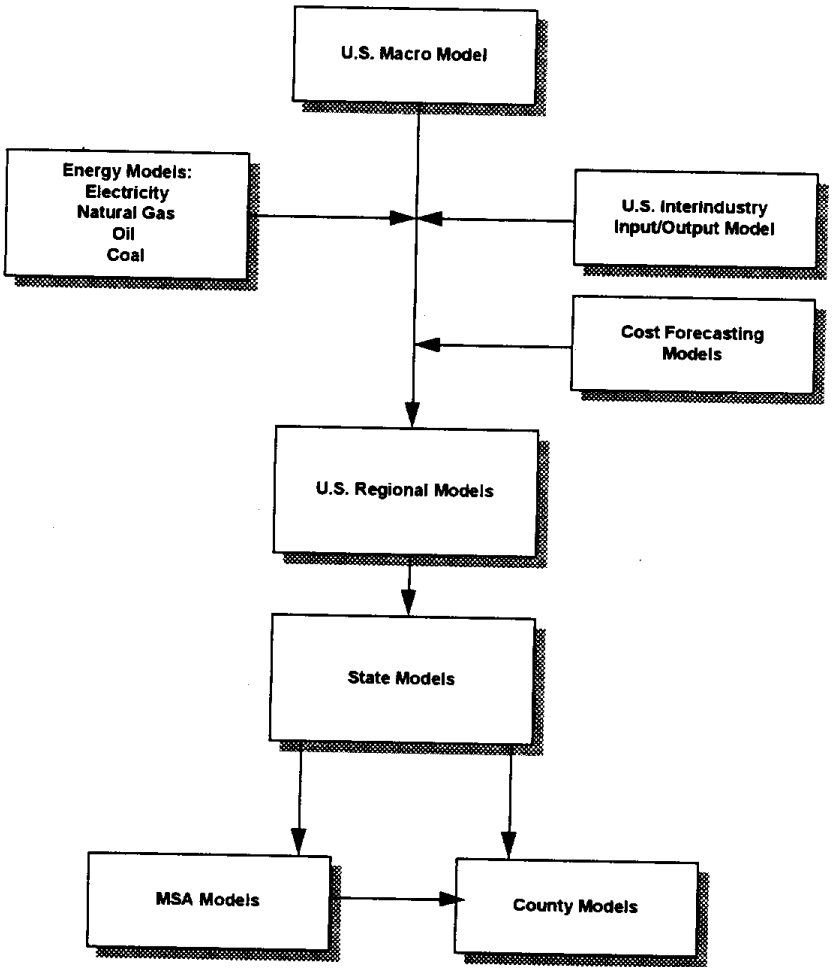
Appendix 2.
The DRI Regional Model

Regional Information Service Methodology

Overview

DRI/McGraw-Hill uses a fully integrated approach to forecasting economic activity at the national, regional, state, metropolitan area, and county levels. DRI's U.S. Quarterly Model determines the national economy's growth path; regions and states compete with each other for available growth. The Regional Information Service uses a system of quarterly models to forecast over 50 concepts for each state and region. The principal indicator of sectoral economic activity is employment, which is forecasted for 20 manufacturing and 10 nonmanufacturing industries. Wage rates and major components of personal income are modeled, as well as homebuilding activity, population, labor force and unemployment rates. In addition to states, DRI's regional modeling system includes consistent projections of employment and other key economic variables for all 313 metropolitan areas and each of 3,143 counties in the United States.

Chart 4
Overview of DRI Regional Modeling System



Simulation of DRI's regional models involves a two-stage process. The core model is first solved for levels of activity in nine regions: New England, Middle Atlantic, South Atlantic, East North Central, East South Central, West North Central, West South Central, Pacific Northwest and Pacific Southwest. The sum of regional economic activity is constrained to sum to the national total. In the second stage, nine regional models are solved to obtain forecasts for the states within each region, constraining state forecasts to add up to regional totals.

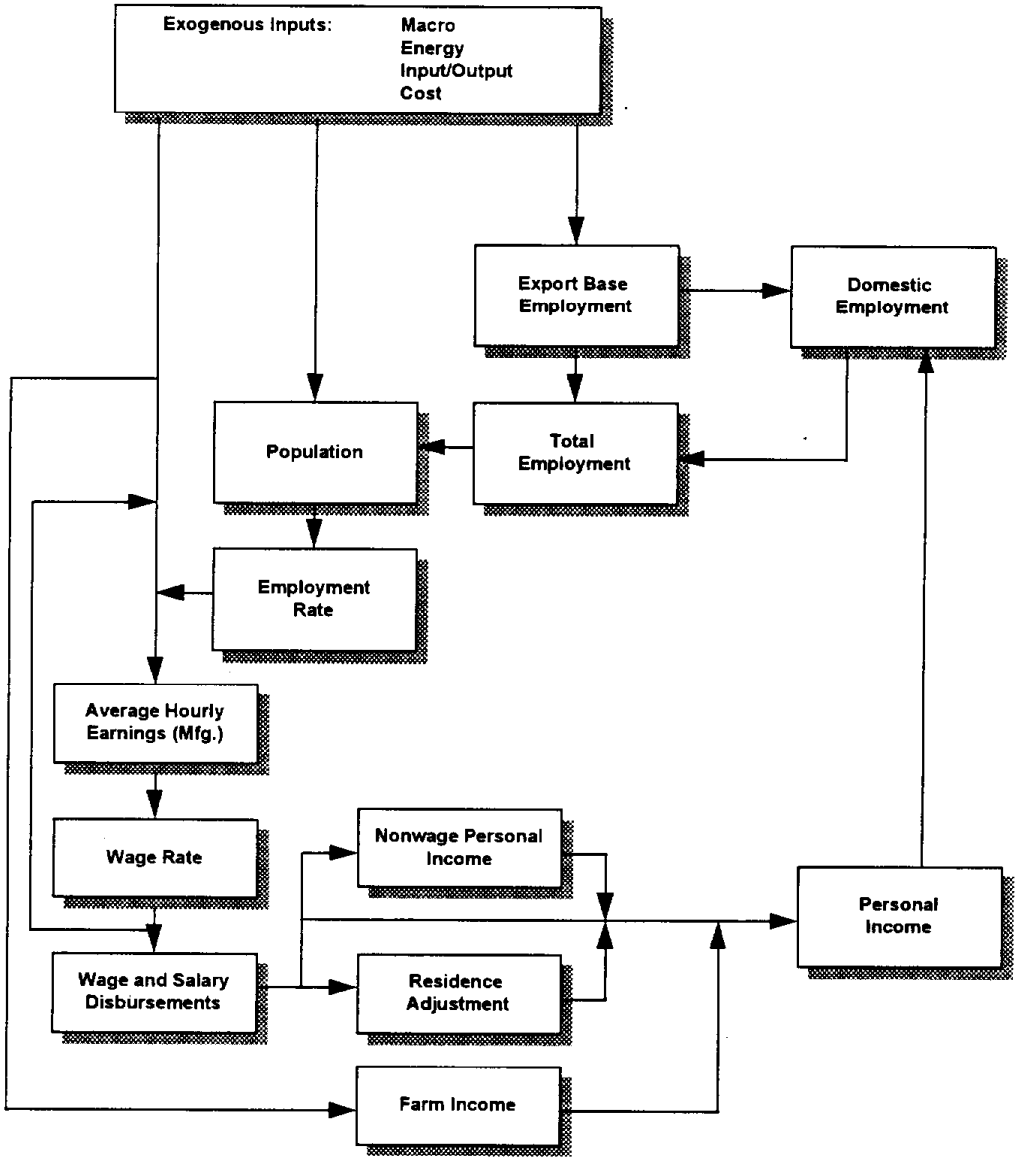
The regional modeling system is based on the premise of regional and state competition, rather than a simple allocation of national economic activity based on fixed relationships. Competition centers around factors influencing a firm's locational decisions. The decision to move between regions is driven by:

- proximity to markets and suppliers,
- costs considerations such as wages, energy prices, housing prices and taxes,
- quality of labor-education and degree of unionization,
- climate, and
- quality of life.

Within a region, the forces affecting business location are more limited. States are essentially competing for a share of the business drawn to that particular region. Business taxation and relative costs are key attributes in determining a state's ability to compete with its neighbors.

DRI's regional models are export base models. The principle underlying the export base structure is that regional growth is generated primarily when locally produced goods and services are sold to customers outside the region. The inflows of income produced by such inter-regional transactions will then generate a multiplier effect on the local economy. In contrast, intra-regional transactions only redistribute income. Those industries which sell their products to markets outside the region constitute the export base. In DRI's regional models, the export base is composed of manufacturing, mining, federal governments, and some portion of other service-related sectors.

Chart 5
DRI Regional Model Structure



Model Coverage

For each region and state, the DRI Regional model includes projections of approximately 100 variables:

- Employment - two-digit SIC for manufacturing, one-digit for nonmanufacturing
- Income by source, wages by one-digit SIC
- Industrial production indexes
- Demographics - population, labor force
- Housing starts, stock
- Other variables: consumer price index, retail sales, unemployment rate, investment in construction

For metropolitan areas, coverage includes:

- Employment by one-digit SIC groupings
- Income - wage and salary, nonwage
- Population
- Additional variables for the Top 100 MSAs (DRI definition) included housing permits, labor force and unemployment rate.

For each county, DRI projects 30 variables, including:

- Employment by one-digit SIC groupings
- Income - wage and salary, nonwage
- Population and heads of households by seven age groups.

Manufacturing Employment

The manufacturing sector is examined in detail, because of its importance in each area's economic base. All of the 20 two-digit SIC industries are analyzed separately, in a pooled time-series cross-sectional framework. This technique makes possible the inclusion of a variety of cross-sectional concepts which could not be used in a conventional time-series regression. These include climate and attractiveness, which do not change over time, and other variables such as unionization, education, personal and business taxes, which change so rarely or so gradually that they are not distinguishable from a time trend in the absence of cross-sectional methods.

Three categories of explanatory variables are used. The first major type of variable explaining these movements relates to the mix of activities within each two-digit SIC sector. Where DRI's national model forecasts at the three-digit level, the historical mix in each region has been used to construct an indicator of the relative growth that the region can expect simply on the basis of differences in three-digit mix.

In addition, another variable has been designed to measure differences in the amplitude of the business cycle in each industry among regions; this allows implicitly for the effects of different three-digit mix even when there are no reliable forecasts of the separate three-digit markets.

Thirdly, the model looks at relative costs of doing business, including wage rates, tax burdens, energy prices (using electricity prices as a proxy), unionization and education of the labor force, and home prices. Most of these are examined both in terms of the impact of existing inter-regional differentials, and also in terms of the effect of different rates of change, in order to distinguish between variables whose effects persist over time, and those which matter only when they change.

Finally, it is clear that a significant factor in many business and personal decisions is the underlying quality of life; the model looks at climate (measured by heating degree days), top personal tax rates, and a general measure of attractiveness (the indicator use is the proportion of total employment

dependent on tourism). Some of the concepts used in RIS may be relevant both to business costs and to the quality of life; specifically, the climate will affect the cost of space-heating for business, and home prices will have an impact on the quality of life for individuals as well as on the price that businesses have to pay both for property and for people.

Not all of these variables are significant in every industry or within every region, but in total they all have a substantial impact on the location of manufacturing jobs. The forecasts of theme come from other DRI services (e.g., electricity prices for the energy service), or are assumptions which can be changed by the user (e.g., unionization, tax rates), or are endogenous to the RIS model (e.g., wage rates, home prices, market demand).

Industrial Production

Data on industrial production by industry has not been available at the state level for a number of years, since budget cuts caused the Bureau of the Census to cease publishing the state results for the annual Survey of Manufacturers. DRI has therefore developed production indices based on national input-output data and state employment statistics. The assumption is made that output per employee is the same in all states at the 432-sector level of detail from DRI's input-output table. This is then combined with data from County Business Patterns on employment by four-digit SIC codes, to generate measures of output per employee by state for two-digit manufacturing industries; these differ from state to state because of the different four-digit mix within each two-digit sector. These two-digit productivity series are then applied to the two-digit employment forecasts from the RIS model to provide levels of industrial output, which are then indexed to a base of 1.0 in 1973 (first quarter).

Non-Manufacturing Employment

Certain elements of non-manufacturing employment are also part of an area's economic base. Mining employment is driven by information from DRI's Coal, Steel and Drilling services, and by the model's own forecast of construction activity. Federal government employment, which is distributed largely on the basis of population, can also be viewed as part of the economic base. Most non-manufacturing sectors, however, are principally driven by the local economy. Construction is entirely oriented towards local demand, being driven by indexes of residential and nonresidential construction activity. The residential index depends on single- and multi-family housing starts in recent quarters; the nonresidential index is a function of positive changes in total nonconstruction employment (representing the demand for new work places), and of the overall level of employment (representing the normal demand for maintenance and alterations of existing structures). State and local government employment is determined by tax revenues, using average business and non-business tax rates in relation to total personal income in the state. The other non-manufacturing sectors are:

- Transportation, communications, and utilities;
- Trade;
- Finance, insurance, and real estate;
- Services.

All of these are primarily driven by local needs, but each contains components that serve wider markets. International and national banking and insurance, many business services, and a wide variety of activities related to tourism, are all examples of economic-base elements within non-manufacturing. The proportion of each of these four sectors which is export-oriented has been estimated by means of a minimum-requirements test. For each sector, the proportion of total employment was calculated for every state and region, and the lowest proportion was used as an indicator of the amount of, for example, service employment which is "needed" by a region. Any employment above that proportion is treated as export-oriented, and is tied in the model to demand in the rest of the region and the rest of the country.

Wages and Incomes

The largest component of personal income is wages and salaries; the model therefore focuses on wage rates, identifying separately hourly wages in manufacturing, and average annual wages and salaries in manufacturing and in non-manufacturing by one-digit SIC sector (the same level of disaggregation as for employment). Average hourly wage rates are forecast using a measure of national wages adjusted for each state's two-digit manufacturing mix. Regional wage rates grow at the rate determined by industry mix, with some tendency to convergence, and also with a pressure for faster growth if total employment is growing faster than in the rest of the country. Non-manufacturing wages follow manufacturing, except that in general they are somewhat more sensitive to transitory labor-market conditions.

For wages, equations were estimated at the national level for average annual wages and salaries in each sector, using forecasts of hourly wage rates from DRI's Cost Forecasting Service where appropriate, and relative sectorial growth in other cases. These national average annual wage rates were then used to generate regional and state forecasts, by imposing the same relative rates of growth. For example, if construction wages in the nation are forecast to grow 10% faster than the average for non-manufacturing in the third quarter of 1985, then this same relationship will be assumed to hold in each region. This does not imply that construction wages will be forecast to grow at the same rate everywhere, since average non-manufacturing wages are forecast for each state and region based on a complex set of factors reflecting economic activity in the area, and these can and do differ substantially from place to place. A constraining procedure is also used to ensure that the total amount of wage and salary disbursements implied by these wage rates is consistent with the national and regional forecasts.

Non-wage income is divided into two aggregates, taxable and non-taxable. The equations for these include terms relating to each major component of non-wage income:

- other labor income;
- Transfer payments (federal and state & local);
- Residence adjustment;
- Non-farm proprietors' income;
- Property income (dividends, interest, and rent).

Each term looks at the relevant national variable, and at a regional concept which can be viewed as driving the particular type of income. Farm proprietors' income is treated separately, using DRI's forecasts of state production and cash receipts from crops and livestock.

The final critical category of income in regional analysis is the residence adjustment; this is required because official estimates of wage income are based on data collected by place of work, while income is defined as place of residence. The adjustment thus represents an addition to income if many residents commute across state lines to work, and a negative number if many of the state's jobs are held by residents of other areas. The specification of the equation for the residence adjustment therefore depends upon the sign of the concept over history; where it is negative, it is estimated as a proportion of total wages and salaries in the state (or region); where it is positive, it has been estimated as a proportion of total wages and salaries in neighboring states or regions to which it appears that area residents commute. Generally, commuting is to and from contiguous areas, which can be easily identified by finding major metropolitan areas that lie across or close to state lines (e.g., New York City); occasionally, specific events cause "commuting" over long distances, such as Texas to Alaska during the construction of the trans-Alaska oil pipeline.

Population and Labor Force

Population in the RIS model is estimated using a pooled time-series cross-sectional technique similar to the manufacturing sector. This ensures that regional population forecasts will add up to the total given by the DRI macroeconomic model (actually, the Census Bureau's middle projection); all

movements of population are therefore balanced, with no people appearing out of thin air (or disappearing).

The main determinant of differential population growth is employment. In the RIS model, people for the most part follow jobs. There is an additional element of migration in response to relative wage rates, and also a non-economic components due to climate and attractiveness; this is largely a reflection of the increasing trend towards retirement in the sun-belt. It seems that in general people move towards fast-growing regions, rather than away from depressed ones, so that there is more movement when the overall economy performs more strongly. This effect is captured in the model by the particular coefficients on relative employment and wage rate growth.

The labor force is forecast as a fraction of total population, taking into account the broad national demographic changes in labor-force participation rates; the regional equations also include a measure of business recessions, to capture what is known as the "discouraged worker" phenomenon--people who cannot find work eventually stop looking.

The unemployment rate is forecast on the basis of labor force and total employment. This equation is not an identity, because the employment statistics are on an establishment (place of work) basis, and exclude agriculture and self-employment, while the labor force and unemployment rate data come from Current Population Survey. This is a household (place of residence) survey, and counts all forms of employment (including even temporary absence from a job due to strikes).

Housing

Housing is modeled in the RIS system using a modified stock-adjustment method. First, a time series was created for the total stock of homes (including mobile homes) by state, using the 1960, 1970, and 1980 Census, together with data on housing starts and mobile home shipments. The implied depreciation rate, which is affected by the actual history of conversions as a proportion of stock, is subject to the forecasters' judgment regarding likely future conversion rates.

Second, an equation was estimated for the actual stock, using population aged 18 to 64, and a composite measure of affordability. This includes average regional household income, interest rates, and regional home prices. This equation was then solved over history, to yield an estimate of the desired, or trend, housing stock.

Total housing starts are estimated on the basis of the gap between the desired an actual stocks, together with affordability (both a long-term moving average and short-term variations around the moving average). Also included is a speculation variable, modeled as the latest four-quarter increase in the desired stock (demand). Thus if demand has been increasing rapidly, builders may keep on building, even after the underlying demographics have turned down. In states where this is an important term in the equation, relatively large cycles may be observed in housing starts.

Total housing starts are divided into singles and multi based both on trends in the national mix, and on regional average incomes, It is assumed that single-family homes are the generally preferred form of housing, and that higher incomes will bring more singles, other things being equal.

Retail Sales

The RIS models include retail sales (durables and nondurables) for the nine regions. Details have now been added for all those states for which data are published, using each state's share of the region's disposable personal income to forecast changes in its share of regional retail sales. Estimates were also made of the implied retail sales in the non-reporting states, so as to ensure that the state and regional forecasts are both realistic and consistent. The state forecasts, like the existing regional series, are broken down into durables and nondurables, since sales in these two major categories respond to different influences, particularly in terms of their behavior over the business cycle.

Consumer Prices

Consumer prices indices do not exist at the state level, despite a widespread need for information on relative inflation in different parts of the country. DRI already forecasts those CPIU's that exist for major metropolitan areas, and has now extended the coverage by using available data on consumer expenditure by region to construct state indices.

These are not based on local price information, but instead utilize information on typical household budgets in the four Census Regions, by size class of metropolitan area. This makes possible the calculation of different weights for the components of the CPI in each state, depending on its Census Region and the sizes of the metropolitan areas in the state. These weights are applied to the national components of the CPI, except that state home prices are used for housing costs. The indices also include the existing forecasts of the 28 published metropolitan CPIU's, weighted by the population of the area relative to its state. The entire system of state and metropolitan indices thus represents a consistent set of indicators of relative rates of inflation; it must be noted, however, that they do not measure relative living costs at one point in time, since they do not embody state-by-state statistics.

Appendix 3.
DRI's Industry Classification by SIC Code

DRI INDUSTRY INFORMATION SERVICE
LONG-TERM MODEL
SECTOR CLASSIFICATION

432 Sector Number	FIM Sector Name / 432 Sector Name	Capital Invest. CF	SIC* Code
	1. LIVESTOCK AND PRODUCTS		
1	Dairy Farm Products	1	02
2	Poultry & Eggs	1	02
3	Livestock	1	02
	2. OTHER AGRICULTURAL PRODUCTS		
4	Cotton	1	01
5	Food Grains	1	01
6	Feed Grains & Grass Seed	1	01
7	Tobacco	1	01
8	Fruits & Nuts	1	01
9	Vegetables	1	01
10	Miscellaneous Crops	1	01
11	Oil Bearing Crops	1	01
	3. FORESTRY & FISHERY PRODUCTS		
12	Forestry Products	1	081–084,097
13	Fishery Products	1	091
	4. AGRICULTURAL, FORESTRY & FISHERY SERVICES		
14	Agricultural, Forestry & Fishery Services	1	0254,Pt. 07,085,092
	5. IRON ORE MINING		
15	Iron & Ferroalloy Ores Mining	2	101,106
	6. NONFERROUS METAL MINING		
16	Copper Ore Mining	3	102
17	Metal Ores Mining, N.E.C.	3	103–105,Pt. 108,109
	7. COAL MINING		
18	Coal Mining	4	1111,Pt.1112,1211,Pt.1213
	8. CRUDE PETROLEUM & NATURAL GAS		
19	Crude Petroleum	5	131,Pt.138
20	Natural Gas	5	132,Pt.138
	9. STONE & CLAY MINING & QUARRYING		
21	Stone/Clay Mining & Quarrying	6	141–5,Pt.148,149
	10. CHEMICALS & FERTILIZER MIN. MINING		

432 Sector Number	FIM Sector Name / 432 Sector Name	Capital Invest. CF	SIC Code
22	Chemical & Fertilizer Mineral Mining	7	147
	11. NEW CONSTRUCTION		
23	New Residential Single-Family Housing	8	Pt.15,Pt.17
24	New Residential Multi-Family Housing	8	Pt.15-17
25	New Residential Additions & Alterations	8	Pt.15,Pt.17
26	New Hotels, Motels, & Dormitories	8	Pt.15-17
27	New Industrial Buildings	8	Pt.15-17
28	New Office Buildings	8	Pt.15-17
29	New Commercial Buildings, Ex. Offices	8	Pt.15,Pt.17
30	New Religious Buildings	8	Pt.15,Pt.17
31	New Educational Buildings	8	Pt.15,Pt.17
32	New Hospital & Institutional Buildings	8	Pt.15,Pt.17
33	New Telephone & Telegraph Facilities	8	Pt.16,Pt.17
34	New Railroads	8	Pt.16,Pt.17
35	New Electric Utility Facilities	8	Pt.16,Pt.17
36	New Gas Utility Facilities	8	Pt.16,Pt.17
37	New Petroleum Pipelines	8	Pt.16,Pt.17
38	New Water Supply Facilties	8	Pt.16,Pt.17
39	New Sewer Facilties	8	Pt.16,Pt.17
40	New Highways & Streets	8	Pt.16,Pt.17
41	New Farm Service Facilities	8	Pt.15,Pt.17
42	New Oil & Gas Well Drilling	8	Pt.138
43	Exploration & Solid Access Structures: Mining	8	Pt.108,Pt.1112,Pt.1231,Pt.148
44	New Military Facilities	8	Pt.15-17
45	New Conservation & Development Fac.	8	Pt.15-17
46	New Construction, N.E.C.	8	Pt.15-17, Pt.108, Pt.1112,Pt.1231,Pt.148
	12. MAINTENANCE & REPAIR CONSTRUCTION		
47	Maintenance & Repair, Residential	8	Pt.15,Pt.17
48	Maintenance & Repair, Private, Nonresidential Incl. School	8	Pt.15-17,Pt.138
49	Maintenance & Repair, Public, Ex. Schools	8	Pt.15-17
	13. ORDNANCE & ACCESSORIES		
50	Complete Guided Missiles	9	3761
51	Ammunition, Except Small Arms, N.E.C.	9	3483
52	Tanks & Tank Components	9	3795
53	Small Arms	9	3484
54	Small Arms Ammunition	9	3482
55	Other Ordnance Accessories	9	3489

432 Sector Number	FIM Sector Name / 432 Sector Name	Capital Invest. CF	SIC Code
	14. FOOD & KINDRED PRODUCTS		
56	Meat Packing Plants	10	2011
57	Other Prepared Meats	10	2013
58	Poultry Dressing Plants	10	2016
59	Poultry & Egg Processing	10	2017
60	Creamery Butter	10	2021
61	Cheese, Natural & Processed	10	2022
62	Condensed & Evaporated Milk	10	2023
63	Ice Cream & Frozen Desserts	10	2024
64	Fluid Milk	10	2026
65	Canned and Cured Seafoods	10	2091
66	Canned Specialties	10	2032
67	Canned Fruits & Vegetables	10	2033
68	Dehydrated Food Products	10	2034
69	Pickles, Sauces & Salad Dressings	10	2035
70	Fresh or Frozen Packaged Fish	10	2092
71	Frozen Fruits & Vegetables, Juices	10	2037,2038
72	Flour & Other Grain Mill Products	10	2041
73	Cereal Preparations	10	2043
74	Blended & Prepared Flour	10	2045
75	Pet Food	10	2047
76	Prepared Feed, N.E.C.	10	2048
77	Rice Milling	10	2044
78	Wet Corn Milling	10	2046
79	Bread, Cake & Related Products	10	2051
80	Cookies & Crackers	10	2052
81	Sugar	10	2061–2063
82	Confectionary Products	10	2065
83	Chocolate & Cocoa Products	10	2066
84	Chewing Gum	10	2067
85	Malt Liquors	10	2082
86	Malt	10	2083
87	Wine, Brandy & Brandy Spirits	10	2084
88	Distilled Liquor, Except Brandy	10	2085
89	Bottled & Canned Soft Drinks	10	2086
90	Flavorings, Extracts & Syrups, N.E.C.	10	2087
91	Cottonseed Oil Mills	10	2074
92	Soybean Oil Mills	10	2075
93	Vegetable Oil Mills, N.E.C.	10	2076
94	Animal & Marine Fats & Oils	10	2077
95	Roasted Coffee	10	2095
96	Shortening & Cooking Oils	10	2079
97	Manufactured Ice	10	2097
98	Macaroni & Spaghetti	10	2098
99	Food Preparations, N.E.C.	10	2099
	15. TOBACCO PRODUCTS		
100	Cigarettes	11	2111
101	Cigars	11	2121
102	Chewing & Smoking Tobacco	11	2131
103	Tobacco, Stemming & Redrying	11	2141

432 Sector Number	FIM Sector Name 432 Sector Name	Capital Invest. CF	SIC Code
	16. FABRIC, YARN & THREAD MILLS		
104	Broadwoven Fabric Plants	12	2211,2221,2231,2261,2262
105	Narrow Fabric Mills	12	2241
106	Yarn Mills & Textile Finishing	12	2269,2281,2282,2283
107	Thread Mills	12	2284
	17. MISC. TEXTILE GOODS		
108	Floor Coverings	13	2271,2272,2279
109	Miscellaneous Textile Products	13	2291–2295
110	Tire Cord & Fabric	13	2296
111	Textile Goods, N.E.C.	13	2297–2299
	18. APPAREL		
112	Hosiery & Knit Goods	14	2251–4,2259
113	Knit Fabric Mills	14	2257,2258
114	Apparel From Purchased Material	14	231–8,39996
	19. MISC. FABRICATED TEXTILE PRODUCTS		
115	Housefurnishings (Incl. Curtains & Other)	15	2391,2392
116	Fabric Textile Products, N.E.C.	15	2393–7,2399
	20. LUMBER & WOOD PRODUCTS		
117	Logging Camps & Contractors	16	2411
118	Sawmills & Planing Mills, General	16	2421
119	Hardwood Dimension & Flooring	16	2426
120	Special Product Sawmills, N.E.C.	16	2429
121	Millwork	16	2431
122	Wood Kitchen Cabinets	16	2434
123	Veneer & Plywood	16	2435,2436
124	Structural Wood Members, N.E.C.	16	2439
125	Prefabricated Wood Structures	16	2452
126	Wood Preserving	16	2491
127	Wood Pallets & Skids	16	2448
128	Particleboard	16	2492
129	Wood Products, N.E.C.	16	2499
	21. WOOD CONTAINERS		
130	Wooden Containers	16	2441,2449
	22. HOUSEHOLD FURNITURE		
131	Wood Household Furniture	17	2511
132	Household Furniture, N.E.C.	17	2519
133	Wood Television & Radio Cabinets	17	2517
134	Upholstered Household	17	2512
135	Metal Household Furniture	17	2514
136	Mattresses & Bedsprings	17	2515

432 Sector Number	FIM Sector Name / 432 Sector Name	Capital Invest. CF	SIC Code
	23. OTHER FURNITURE & FIXTURES		
137	Wood Office Furniture	18	2521
138	Metal Office Furniture	18	2522
139	Public Building Furniture	18	2531
140	Wood Paritions & Fixtures	18	2541
141	Metal Partitions & Fixtures	18	2542
142	Venetian Blinds & Shades	18	2591
143	Furniture & Fixtures, N.E.C.	18	2599
	24. PAPER & ALLIED PRODUCTS		
144	Pulp Mills	19	2611
145	Paper Mills, Except Building Paper	19	2621
146	Paperboard Mills	19	2631
147	Envelopes	19	2642
148	Sanitary Paper Products	19	2647
149	Building Paper & Board Mills	19	2661
150	Paper Coating & Glazes	19	2641
151	Bags, Except Textile Bags	19	2643
152	Die-Cut Paper & Board	19	2645
153	Pressed & Molded Pulp Goods	19	2646
154	Stationary & Misc. Converted Products	19	2648,2649
	25. PAPERBOARD CONTAINERS & BOXES		
155	Paperboard Container & Boxes	20	265
	26. PRINTING & PUBLISHING		
156	Newspapers	21	2711
157	Periodicals	21	2721
158	Book Publishing	21	2731
159	Book Printing	21	2732
160	Miscellaneous Publishing	21	2741
161	Commercial Printing	21	2751,2752,2754
162	Manifold Business Forms	21	2761
163	Blankbooks & Looseleaf Binders	21	2782
164	Greeting Card Publishing	21	2771
165	Engraving & Plate Printing	21	2753
166	Bookbinding & Related Work	21	2789
167	Printing Trade Services	21	2791,2793,2794,2795
	27. CHEMICALS & PRODUCTS		
168	Inorganic & Organic Chemicals	22	2812,2813,2816,2819 Ex.28195,2865,2869
169	Fertilizers	22	2873,2874
170**	Fertilizers, Mixing Only	22	2875
171	Agricultural Chemicals, N.E.C.	22	2879
172	Gum & Wood Chemicals	22	2861
173	Adhesives & Sealants	22	2891
174	Explosives	22	2892
175	Printing Ink	22	2893
176	Carbon Black	22	2895
177	Chemical Preparations, N.E.C.	22	2899

432 Sector Number	FIM Sector Name 432 Sector Name	Capital Invest. CF	SIC Code
	28. PLASTIC & SYNTHETIC MATERIALS		
178	Plastic Materials & Resins	23	2821
179	Synthetic Rubber	23	2822
180	Cellulosic Man-Made Fibers	23	2823
181	Organic Fibers, Noncellulosic	23	2824
	29. DRUGS, CLEANING & TOILET PREPARATIONS		
182	Drugs	24	2831,2833,2834
183	Soap & Other Detergents	24	2841
184	Polishes & Sanitation	24	2842
185	Surface Active Agents	24	2843
186	Toilet Preparations	24	2844
	30. PAINTS & ALLIED PRODUCTS		
187	Paints & Allied Products	25	2851
	31. PETROLEUM REFINING & RELATED PRODUCTS		
188	Petroleum Refining	26	2911
189	Lubricating Oils and Greases	26	2992
190	Production of Petroleum & Coal Products, N.E.C.	26	2999
191	Paving Mixtures & Blocks	26	2951
192	Asphalt Felts & Coatings	26	2952
	32. RUBBER & MISC. PLASTIC PRODUCTS		
193	Tires & Inner Tubes	27	3011
194	Rubber & Plastics Footwear	27	3021
195	Reclaimed Rubber	27	3031
196	Fabricated Rubber Products, N.E.C.	27	3069
197	Miscellaneous Plastic Products	27	3079
198	Hose & Belting	27	3041
	33. LEATHER TANNING & FINISHING		
199	Leather Tanning & Finishing	28	3111
	34. FOOTWEAR & OTHER LEATHER PRODUCTS		
200	Footwear, Cut Stock	28	3131
201	Footwear, N.E.C.	28	3142-3144,3149
202	Leather Gloves & Mittens	28	3151
203	Luggage	28	3161
204	Leather Goods, N.E.C.	28	3171,3172,3199
	35. GLASS & GLASS PRODUCTS		
205	Glass & Products, Except Containers	29	3211,3229,3231
206	Glass Containers	29	3221

432 Sector Number	FIM Sector Name 432 Sector Name	Capital Invest. CF	SIC Code
	36. STONE & CLAY PRODUCTS		
207	Cement, Hydraulic	30	3241
208	Structural Clay Products	30	325
209	Kitchen Pottery	30	3262,3263,3269
210	Porcelain Plumbing & Electrical Supplies	30	3261,3264
211	Concrete Block & Brick	30	3271
212	Concrete Product, N.E.C.	30	3272
213	Ready-Mixed Concrete	30	3273
214	Lime	30	3274
215	Gypsum Products	30	3275
216	Cut Stone & Stone Products	30	3281
217	Abrasive Products	30	3291
218	Asbestos Products & Sealing Devices	30	3292,3293
219	Minerals, Ground or Treated	30	3295
220	Mineral Wool	30	3296
221	Nonclay Refractories	30	3297
222	Nonmetallic Mineral Products, N.E.C.	30	3299
	37. PRIMARY FERROUS METALS		
223	Blast Furnaces & Steel Mills	31	3312
224	Electrometallurgical Products	31	3313
225	Steel Wire & Related Products	31	3315
226**	Cold Finishing Steel Shapes	31	3316
227**	Steel Pipe & Tubes	31	3317
228	Iron & Steel Foundries	31	3321,3322,3324,3325
229	Iron & Steel Forgings	31	3462
230	Metal Heat Treating	31	3398
231	Primary Metal Products, N.E.C.	31	3399
	38. NONFERROUS METALS		
232	Primary Copper	32	3331
233	Primary Lead	32	3332
234	Primary Zinc	32	3333
235	Primary Aluminum	32	3334
236	Primary Nonferrous Metals, N.E.C.	32	3339
237**	Secondary Nonferrous Metals	32	3341
238	Copper Rolling & Drawing	32	3351
239	Aluminum Rolling & Drawing	32	3353-3355
240	Nonferrous Rolling & Drawing, N.E.C.	32	3356
241	Nonferrous Wire Drawing & Insulating	32	3357
242	Aluminum Castings	32	3361
243	Brass, Bronze, & Copper Castings	32	3362
244	Nonferrous Castings, N.E.C.	32	3369
245	Nonferrous Forgings	32	3463
	39. METAL CONTAINERS		
246	Metal Cans	33	3411
247	Metal Barrels, Drums & Pails	33	3412

432 Sector Number	FIM Sector Name 432 Sector Name	Capital Invest. CF	SIC Code
	40. FABRICATED STRUCTURAL METAL PRODUCTS		
248	Metal Sanitary Ware	34	3431
249	Plumbing Fittings & Trim	34	3432
250	Heating Equipment, Exc. Electrical	34	3433
251	Fabricated Structural Metal	34	3441
252	Metal Doors, Sash & Trims	34	3442
253	Fabricated Plate Work(Boiler Shops)	34	3443
254	Sheet Metal Work	34	3444
255	Architectural Metal Work	34	3446
256	Misc. Metal Work & Prefabricated Metal Buildings	34	3448,3449
	41. SCREW MACHINE PROD. & STAMPINGS		
257	Screw Mach. Products & Fasteners	35	345
258	Automotive Stampings	35	3465
259	Other Metal Stampings	35	3466,3469
	42. OTHER FABRICATED METAL PRODUCTS		
260	Cutlery	36	3421
261	Hand & Edge Tools, N.E.C.	36	3423
262	Hand Saws & Saw Blades	36	3425
263	Hardware, N.E.C.	36	3429
264	Plating & Polishing	36	3471
265	Metal Coating & Allied Services	36	3479
266	Misc. Fabricated Wire Products	36	3495,3496
267	Steel Springs	36	3493
268	Pipe Valves & Pipe Fittings	36	3494,3498
269	Metal Foil & Leaf	36	3497
270	Fabricated Metal Products, N.E.C.	36	3499
	43. ENGINES & TURBINES		
271	Steam Engines & Turbines	37	3511
272	Internal Combustion Engines, N.E.C.	37	3519
	44. FARM & GARDEN MACHINERY		
273	Farm Machinery	38	3523
274	Lawn & Garden Equipment	38	3524
	45. CONSTRUCTION & MINING MACHINERY		
275	Construction Machinery	39	3531
276	Mining Machinery, Except Oil	39	3532
277	Oil Field Machinery	39	3533
	46. MATERIALS HANDLING MACHINERY & EQUIPMENT		
278	Elevators & Moving Stairways	40	3534
279	Conveyors & Conveying Equipment	40	3535
280	Hoists, Cranes & Monorail Systems	40	3536
281	Industrial Trucks & Tractors	40	3537

432 Sector Number	FIM Sector Name 432 Sector Name	Capital Invest. CF	SIC Code
	47. METALWORKING MACHINERY & EQUIPMENT		
282	Machine Tools, Metal Cutting	41	3541
283	Machine Tools, Metal Forming	41	3542
284	Special Dies, Tools, Accessories	41	3544,3545
285	Power Driven Hand Tools	41	3546
286	Rolling Mill Machinery	41	3547
287	Metalworking Machinery, N.E.C.	41	3549
	48. SPECIAL INDUSTRIAL MACHINERY		
288	Food Products Machinery	42	3551
289	Textile Machinery	42	3552
290	Woodworking Machinery	42	3553
291	Paper Industries Machinery	42	3554
292	Printing Trades Machinery	42	3555
293	Special Industry Machinery, N.E.C.	42	3559
	49. GENERAL INDUSTRY MACHINERY		
294	Pumps & Compressors	43	3561,3563
295	Ball & Roller Bearings	43	3562
296	Blowers & Fans	43	3564
297	Industrial Patterns	43	3565
298	Power Transmission Equipment	43	3566,3568
299	Industrial Furnaces & Ovens	43	3567
300	Gen. Industrial Machinery, N.E.C.	43	3569
	50. MISCELLANEOUS NONELECTRICAL MACHINERY		
301	Carburetors, Pistons, Rings & Valves	44	3592
302	Nonelectrical Machinery, N.E.C.	44	3599
	51. OFFICE, COMPUTING & ACCOUNTING MACHINERY		
303	Electronic Computing Equip.	45	3573
304	Calculating & Accounting Machinery	45	3574
305	Scales & Balances, exc. Lab	45	3576
306****	Office Machines, N.E.C.	45	3579
	52. SERVICE INDUSTRY MACHINES		
307	Automatic Merchandising Machinery	46	3581
308	Commercial Laundry Equipment	46	3582
309	Refrigeration & Heating Equipment	46	3585
310	Measuring & Dispensing Pumps	46	3586
311	Service Industry Machinery, N.E.C.	46	3589
	53. ELECTRICAL MACHINERY		
312	Electric Measuring Instruments	47	3825
313	Transformers	47	3612
314	Switchgear & Switchboard	47	3613
315	Motors & Generators	47	3621
316	Industrial Controls	47	3622
317	Welding Apparatus	47	3623
318	Carbon & Graphite Products	47	3624
319	Electric Indust. Apparatus, N.E.C.	47	3629

320	Household Cooking Equipment	48	3631
321	Household Refrigerators & Freezers	48	3632
322	Household Laundry Equipment	48	3633
323	Electric Housewares & Fans	48	3634
324	Household Vacuum Cleaners	48	3635
325	Sewing Machines	48	3636
326	Household Appliances, N.E.C.	48	3639
	55. ELECTRIC LIGHTING & WIRING EQUIPMENT		
327	Electric Lamps	49	3641
328	Lighting Fixtures	49	3645–3648
329	Wiring Devices	49	3643,3644
	56. RADIO, T.V. & COMMUNICATION EQUIPMENT		
330	Radio & Television Receiving Sets	50	3651
331	Phonograph Records & Tape	50	3652
332	Telephone & Telegraph Equipment	50	3661
333	Radio & T.V. Communication Equip.	50	3662
	57. ELECTRONIC COMPONENTS & ACCESSORIES		
334	Electron Tubes	51	3671
335	Semiconductors	51	3674
336	Electronic Capacitors	51	3675
337	Resistors, for Electronic Appliances	51	3676
338	Electronic Coils, Tranformers and Other Inductors	51	3677
339	Connectors, for Electronic Appliances	51	3678
340	Electronic Components, N.E.C.	51	3679
	58. MISC. ELECTRICAL MACHINERY & EQUIPMENT		
341	Storage Batteries	52	3691
342	Primary Batteries, Dry & Wet	52	3692
343	X–Ray Apparatus & Tubes	52	3693
344	Engine Electrical Equipment	52	3694
345	Electrical Equipment, N.E.C.	52	3699
	59. MOTOR VEHICLES & EQUIPMENT		
346	Truck & Bus Bodies	53	3713
347	Truck Trailers	53	3715
348	Motor Vehicles – Autos	53	Pt. 3711
349	Motor Vehicles – Other	53	Pt. 3711
350	Motor Vehicle Parts & Accessories	53	3714
	60. AIRCRAFT & PARTS		
351	Aircraft	54	3721
352	Aircraft Engines & Engine Parts	54	3724,3764
353	Aircraft Parts & Equipment, N.E.C.	54	3728,3769

432 Sector Number	FIM Sector Name 432 Sector Name	Capital Invest. CF	SIC Code
	61. OTHER TRANSPORTATION		
354	Shipbuilding & Repairing	55	3731
355	Boatbuilding & Repairing	55	3732
356	Railroad Equipment	55	3743
357	Motorcycles, Bicycles & Parts	55	3751
358	Travel & Campers	55	3792,3716
359	Mobile Homes	55	2451
360	Transportation Equipment, N.E.C.	55	3799
	62. INSTRUMENTS & SUPPLIES		
361	Engineering & Scientific Instruments	56	3811
362	Measuring & Control Instruments	56	382, Ex. 3825
363	Surgical & Medical Instruments	56	3841
364	Surgical Appliances & Supplies	56	3842
365	Dental Equipment & Supplies	56	3843
366	Watches & Clocks	56	3873
	63. OPTICAL, OPHTHALMIC & PHOTO EQUIPMENT		
367	Optical Instruments & Lenses	57	3832
368	Ohpthalmic Goods	57	3851
369	Photographic Equipment & Supplies	57	3861
	64. MISCELLANEOUS MANUFACTURING		
370	Jewelry, Precious Metal	58	3911
371	Jewelers' Materials	58	3915
372	Silverware & Plated Ware	58	3914
373	Costume Jewelry	58	3961
374	Musical Instruments & Parts	58	3931
375	Toys & Sporting Goods	58	3942,3944,3949
376	Office & Artists' Materials	58	395
377	Miscellaneous Notions	58	396,Ex.3961
378	Brooms & Hard Surface Floor Coverings	58	3991,3996
379	Misc. Manufacturing Durable Goods	58	3993,3995,3999
	65. TRANSPORTATION & WAREHOUSING		
380	Railroads & Rail-Related Services	59	40,474,Pt.4789
381	Passenger Transportation, N.E.C.	61	41
382	Motor Freight	61	42,Pt. 4789
383	Water Transportation & Related Services	61	44
384	Air Carriers & Related Services	60	45
385	Pipelines, Except Natural Gas	61	46
386	Transportation Services, N.E.C.	61	Pt. 47
	66. COMMUNICATIONS, EXCEPT RADIO & T.V.		
387	Communications, Except Radio & Television	62	48,Ex. 483
	67. RADIO & T.V. BROADCASTING		
388	Radio & T.V. Broadcasting	62	483

432 Sector Number	FIM Sector Name / 432 Sector Name	Capital Invest. CF	SIC Code
	68. UTILITIES		
389	Electric Utilities	63	491, Pt. 493
390	Gas Utilities	63	492, Pt. 493
391	Water & Sewer Services	63	494–497,Pt. 493
	69. WHOLESALE AND RETAIL TRADE		
392	Wholesale Trade	64	50,51
393	Retail Trade	64	52–57,59,7396,8042
	70. FINANCE & INSURANCE		
394	Banking	65	60
395	Credit Agencies & Security Brokers	65	61,62,67
396	Insurance Carriers & Agents	65	63,64
	71. REAL ESTATE & RENTALS		
397	Owner–Occupied Dwellings	66	NA
398	Real Estate	66	65,66,Pt. 1531
	72. PERSONAL SERVICES EXCEPT AUTOMOTIVE		
399	Hotels & Lodging Places	67	Pt. 70(Exc. Dining)
400	Miscellaneous Personal Services, N.E.C.	67	Pt. 72,762–764
401	Beauty & Barber Shops	67	723–724
	73. BUSINESS SERVICES		
402	Personnel Supply Services	68	736
403	Computer & Data Processing	68	737
404	Management Consulting, Labs	68	7391,7392,7397
405	Equipment Renting & Leasing	68	7394
406	Other:Misc. Repair Shops, Services to Dwellings, Detective Services, Photo Labs, Copying, Photog., Other Business Services	68	769,734,7393,7332–3, 7395,732,7331,7339 735,7399
407	Advertising: Newspaper	68	731
408	Advertising: Magazine	68	731
409	Advertising: T.V.	68	731
410	Advertising: Radio	68	731
411	Advertising: Other	68	731
412	Legal Services	68	811
413	Engineering, Architecture, & Surveying	68	8911
414	Accounting, Auditing, & Miscellaneous Professional	68	893,899
	74. EATING & DRINKING PLACES		
415	Eating & Drinking Places	64	58,Pt. 70

432 Sector Number	FIM Sector Name 432 Sector Name	Capital Invest. CF	SIC Code
	75. AUTOMOBILE REPAIR & SERVICE		
416	Auto Rental & Leasing (Without Drivers)	69	751
417	Auto Repair, Parking & Washing	69	753,7549,752,7542
	76. AMUSEMENTS		
418	Motion Pictures	70	78
419	Amusement & Recreation Services	70	79
	77. MISCELLANEOUS SERVICES		
420	Doctors & Dentists	71	801–803,8041
421	Hospitals	71	806
422	Nursing & Personal Care	71	805
423	Other Medical Services	71	074,8049,807–809
424	Educational Services	71	82
425	Nonprofit Organizations	71	84,86,8922
426	Social Services, N.E.C.	71	83
	78. FEDERAL GOVERNMENT ENTERPRISES		
427	U.S. Postal Service	NA	4311
428	Other Federal Gov't Enterprises	NA	NA
	79. STATE & LOCAL GOVERNMENT		
429	State & Local Gov't Enterprises	NA	Pt. 41
	80. NONCOMPARABLE IMPORTS		
430**	Noncomparable Imports	NA	NA
	81. SCRAP, USED & SECONDHAND GOODS		
431**	Scrap, Used & Secondhand Goods	NA	NA
	82. DUMMY SECTOR		
432**	Dummy Sector	NA	NA

* SIC codes are listed as 1977 definitions, in order to match the 1977 Input/Output classifications. The data are collected at the 1987 definitions, translated to 1977 for use in the model, and translated back to 1987 definitions for reporting.

** Sectors 170, 226, 227, and 237 do not have product output series because of the similarity of the products produced by these sectors and products identified elsewhere in the input–output table.

*** Sectors 430–432, the dummy sectors, do not have output on an industry basis.

**** Sector 306 includes typewriters.

DRI INDUSTRY INFORMATION SERVICE
LONG-TERM MODEL
FINAL DEMAND CLASSIFICATION

Final Demand Categories	Category Description
	Personal Consumption Expenditures
1.	New Autos, Domestic
2.	New Autos, Foreign
3.	Net Purchase, Used Autos
4.	Recreational Vehicles
5.	Trucks
6.	Tires
7.	Motor Vehicle Accessories & Parts
8.	Furniture, Incl. Mattresses & Bedding
9.	Appliances
10.	China, Glassware & Utensils
11.	Floor Coverings
12.	Misc. Household Furniture
13.	Writing Equipment
14.	Hand, Power & Garden Tools
15.	Radios, TVs, Records, & Musical Inst.
16.	Jewelry & Watches
17.	Opthalmic & Orthopedic Goods
18.	Books & Maps
19.	Boats
20.	Airplanes
21.	Wheel Goods, Toys, Sporting Equip.
22.	Footwear
23.	Clothing
24.	Food, Off-Premise
25.	Alcohol, Off-Premise
26.	Purchased Meals & Beverages
27.	Gasoline
28.	Fuel Oil & Coal
29.	Tobacco
30.	Toilet Articles
31.	Semidurable Housefurnishings
32.	Lighting Supplies
33.	Cleaning Preparations
34.	Household Paper Products
35.	Stationery & Writing Supplies
36.	Drug Preparations
37.	Magazines, Newspapers, Etc
38.	Nondurable Toys & Sporting Goods
39.	Flowers, Seeds, & Plants
40.	Expend Abroad by U.S. Residents
41.	Personal Remittances to Foreigners
42.	Electricity
43.	Natural Gas
44.	Sanitary Services
45.	Telephone & Telegraph
46.	Domestic Services
47.	Misc. Household Services
48.	Owner-Occupied Housing (Imputed)
49.	Tenant-Occupied Housing
50.	Car Repair, Washing, Storage, Rental
51.	Transportation Tolls
52.	Net Car Insurance
53.	Misc. Transportation
54.	Rail Transportation
55.	Airline Transportation
56.	Misc. Personal Services
57.	Barber Shops, Health Clubs
58.	Brokerage Services
59.	Banking Services
60.	Financial Services, N.E.C.
61.	Life Insurance Expenses
62.	Legal Services
63.	Personal Business Services
64.	Radio & TV Repair
65.	Motion Picture Theatres
66.	Misc. Amusements
67.	Other Recreation
68.	Doctors & Dentists
69.	Misc. Professional Medical Services
70.	Hospitals & Sanitariums, Private
71.	Health Insurance
72.	Private Education & Research
73.	Religious & Welfare Activities
74.	Foreign Travel by U.S. Residents
75.	Expenditures in U.S. by Foreigners.

Final Demand Categories	Category Description
	Residential Investment
76.	Residential Single–Family Housing
77.	Residential Multi–Family Housing
78.	Mobile Homes
79.	Residential Additions & Alterations
80.	Residential Nonhousekeeping
81.	Residential Broker Commissions and Net Used
	Nonresidential Investment – Structures
82.	Industrial Buildings
83.	Office Buildings
84.	Other Commercial Buildings
85.	Religious Buildings
86.	Educational Buildings
87.	Hospitals & Institutional Buildings
88.	Misc. Buildings
89.	Hotels & Motels
90.	Railroads
91.	Telephone & Telegraph Facilities
92.	Electric Utility Facilities
93.	Gas Utility Facilities
94.	Petroleum Pipelines
95.	Farm Service Facilities
96.	Petroleum & Natural Gas Exploration & Drilling
97.	Other Mining Facilities
98.	Other Nonbuildings
99.	Broker Commissions & Net Used
	Government Construction
100.	Gov't Residential Buildings
101.	Gov't Industrial Buildings
102.	Gov't Educational Buildings
103.	Gov't Hospitals
104.	Gov't Misc. Buildings
105.	Gov't Highways & Streets
106.	Gov't Military Facilities
107.	Gov't Cons. & Devel. Facilities
108.	Gov't Sewer Facilities
109.	Gov't Water Supply Facilities
110.	Gov't Misc. Nonbuilding
111.	Gov't Net Used

Final Demand Categories	Category Description
	Nonresidential Investment – Equipment
112.	Furniture & Fixtures
113.	Fabricated Metal Products
114.	Engines & Turbines
115.	Tractors
116.	Agricultural Machinery
117.	Construction Machinery
118.	Mining & Oilfield Machinery
119.	Metalworking Machinery
120.	Special Industry Machinery, N.E.C.
121.	General Industry Machinery
122.	Office Equipment
123.	Service Industry Machinery
124.	Electrical Transmission Equipment
125.	Communication Equipment
126.	Misc. Electrical Equipment
127.	Trucks & Buses
128.	Autos – New
129.	Aircraft
130.	Ships & Boats
131.	Railroad Equipment
132.	Instruments
133.	Photographic Equipment
134.	Other Nonresidential Producer's Durable Equipment
135.	Scrap, Auto (Net Used)
136.	Scrap, Exc. Auto
137.	Residential Producer's Durable Equipment
	Government, Excluding Construction
138.	Federal Defense, Ex. Construction
139.	Federal Nondefense – Compensation
140.	Federal Nondefense – Purchases, Ex. Construction
141.	State & Local Education – Compensation
142.	State & Local Education – Purchases, Ex. Construction
143.	State & Local Other – Compensation
144.	State & Local Other – Purchases, Ex. Construction

Final Demand Categories	Category Description
	Exports
145.	Foods, Feeds & Beverages
146.	Industrial Supplies & Materials
147.	Capital Goods, Ex. Autos & Computers
148.	Automotive Vehicles, Parts, Etc.
149.	Consumer Goods, Ex. Food & Auto
150.	Misc. Services
151.	Factor Income
	Imports
152.	Foods, Feeds & Beverages
153.	Supplies & Materials Ex. Fuels
154.	Fuels & Lubricants
155.	Capital Goods, Ex. Autos & Computers
156.	Automotive Vehicles, Parts, Etc.
157.	Consumer Goods, Ex. Food & Auto
158.	Misc. Services
159.	Factor Income
	Inventory Change
160.	Agriculture
161.	Nonmanufacturing
162.	Manufacturing
163.	Allocated Raw Materials
164.	Allocated Wholesale Trade
165.	Allocated Retail Trade
	Computer Trade
166.	Exports Computers & Peripherals
167.	Imports Computers & Peripherals

DRI INDUSTRY INFORMATION SERVICE
LONG-TERM MODEL
CAPITAL FLOWS CLASSIFICATION

Capital Flow Number	Sector Description	Flow Number	Capital Sector Description
1.	Agriculture	37.	Engines & Turbines
2.	Iron Ore Mining	38.	Farm & Garden Machinery
3.	Nonferrous Metal Mining	39.	Construction & Mining Machinery
4.	Coal Mining	40.	Mat. Handling Machinery & Equip.
5.	Crude Petroleum & Natural Gas	41	Metalworking Machinery & Equip.
6.	Stone & Clay Mining & Quarrying	42.	Special Industrial Machinery
7.	Chem. & Fert. Mineral Mining	43.	General Industrial Machinery
8.	Construction	44.	Misc. Nonelectrical Machinery
9.	Ordnance & Accessories	45.	Office, Computing & Acct. Mach.
10.	Food & Kindred Products	46.	Service Industry Machinery
11.	Tobacco Manufacturers	47.	Electrical Machinery
12.	Fabric, Yarn & Thread Mills	48.	Household Appliances
13.	Misc. Textile Goods	49.	Electrical Lighting & Wiring Equip.
14.	Apparel	50.	Radio, TV & Commun. Equip.
15.	Misc. Fabricated Textile Products	51.	Electronic Components & Access.
16.	Lumber & Wood Products	52.	Misc. Elect. Machinery & Equip.
17.	Household Furniture	53.	Motor Vehicles & Equipment
18.	Other Furniture & Fixtures	54.	Aircraft & Parts
19.	Paper & Allied Products	55.	Other Transportation Equipment
20.	Paperboard Containers & Boxes	56.	Instruments & Supplies
21.	Printing & Publishing	57.	Optical, Opthalmic & Photo. Equip.
22.	Chemicals & Products	58.	Misc. Manufacturing
23.	Plastics & Synthetic Materials	59.	Railroad Transportation
24.	Drugs & Cleaning Preparations	60.	Air Transportation
25.	Paints & Allied Products	61.	Other Transportation Services
26.	Petroleum Refining & Products	62.	Communication Services
27.	Rubber & Misc. Plastics	63.	Utilities
28.	Leather & Products	64.	Wholesale & Retail Trade
29.	Glass & Products	65.	Finance & Insurance
30.	Stone & Clay Products	66.	Real Estate & Rental
31.	Primary Ferrous Metals	67.	Personal Services Exc. Auto
32.	Nonferrous Metals	68.	Business Services
33.	Metal Containers	69.	Auto Repair & Services
34.	Fab. Structural Metal Products	70.	Amusements
35.	Screw Mach. Prods. & Stampings	71.	Misc. Services
36.	Other Fab. Metal Products		

Appendix 4. DRI's State Industry Forecasting System

The Regional-Industry Link

The Regional Industry Forecasting System links together the Interindustry and Regional Models to provide annual output and employment forecasts at the state and regional level for 432 industries. The modes are "linked" in the sense that national output and employment forecasts generated by the Interindustry Model are shared down to the region and state level with employment forecasts generated by the Regional (RIS) model.

It is important to stress here, however, that the Regional Industry Forecasting System is NOT a regional input-output model. A regional input-output model consists of a set of regional input-output tables linked together by trade flows. The lack of current regional input-output tables precludes the construction of such a model at this time.

A. Methodology

a. Benchmarking the Data

In order to determine a benchmark level of employment by industry for each of the 9 RIS regions and the 50 states, 4-digit County Business Pattern (CBP) data are used to share down the national industry totals. The CBP data set contains data on employment by 4-digit SIC code by county. Due to disclosure problems and the inconsistent reporting practices among states, a joint effort, undertaken by DRI and NPDC, was made to construct a complete and consistent data base converting the entire economy. The data were aggregated to the state level and to 432 industries (approximately 4-digit SIC level).

National industry employment levels are available for 432 industries from the Interindustry Service. For an example benchmark year such as 1986, these employment levels were distributed to the state level as follows:

$$EMP@IND_i@STATE_j = EMP@IND_i * \frac{CBP@IND_i@STATE_j}{CBP@IND_1}$$

where:

$EMP@IND_i@STATE_j$ = employment in industry i in state j in 1986,

$EMP@IND_i$ = national employment in industry i (from Interindustry Service) in 1986,

$\frac{CBP@IND_i@STATE_j}{industry\ i\ in\ state\ j\ in\ total\ CBP}$ = share of CBP employment of $CBP@IND_i$ employment in 1986,

i=1,432

j=1,50

That is, in order to derive 1986 benchmarks of state employment levels consistent with the national employment totals, as provided by the Interindustry Service, the CBP data were used as the sharing device. As a result of this sharing process, a set of 4-digit (432 sector) benchmark employment levels were created for each state and region for 1986.

The state and regional employment levels for 4-digit industries were then aggregated to 77 sectors (2-3 digit levels) for 1986. These were then considered as the benchmark state and regional employment by industry for the Regional Industry Forecasting System.

b. Time Series Data

The improved CBP data are available annually from 1975 to 1990. Consistent and comprehensive disaggregate time series data of state employment by industry are not available. The Regional Information Service (RIS) has developed a consistent data base on employment by state at the 2-digit level. Lacking more disaggregate data, time series of state employment for each of the 432 sectors were constructed by indexing each sector's benchmark employment level with the appropriate 2-digit series from RIS, as follows:

$$EMP@IND_i@STATE_j^t = EMP@ING_i@STATE_j^{86} * EMP@2\text{-}DIG@STATE_j^t$$

where:

$EMP@IND_i@STATE_j^t$ = employment in industry i in state j at time t,

$EMP@IND_i@STATE_j^{86}$ = employment in industry i in state j in 1986 (benchmark)

$EMP@2-DIG@STATE_j^t$ = index of employment in the relevant 2-digit industry in state j at time t (from RIS)

Because of the methodology employed to calculate state employment levels by industry (i.e., by indexing the benchmark levels), total employment in a given industry across all states need not necessarily sum to the national total for that industry. As a result, an algorithm was developed which insured that employment in an industry summed across states was constrained to the pre-determined national total. This constraint holds both for the historical and forecast intervals.

c. Output Data

The Interindustry Service provided data and forecasts on output (i.e., production levels) as well as employment. This means that labor productivity (output per employee) levels can be calculated for each industry at the national level. If the assumption is made that labor productivity in an industry does not vary across regions and states, then output levels by industry by state and region can be derived as follows:

$$OUT@IND_i@STATE_j^t = EMP@IND_i@STATE_j^t * \frac{OUT@IND_j^t}{EMP@IND_j^t}$$

where:

$OUT@IND_i@STATE_j^t$ = output of industry in state j at time t,

$EMP@IND_i@STATE_j^t$ * = employment in industry i in state j at time t,

$\frac{OUT@IND_j^t}{EMP@IND_j^t}$ = $\frac{\text{national (average) productivity level of industry } i \text{ at time } t}{\text{(output / employee)}}$

Output levels (measured in constant 1977 dollars) were calculated for 432 industries for 51 states and 9 RIS regions. These are available historically beginning in 1990, as well as over the forecast interval.

d. Industry vs. Commodity Based Data

The Interindustry Service provides historical data and forecasts on output and employment focusing on a commodity rather than an industry base. This focus is in contrast to the DRI U.S. and Regional economic models, which use variables defined on an industry basis.

Output defined on an industry base is the total production of an industry, which is a collection of establishments. An industry or establishment, however, may produce more than one commodity. For example, petroleum refiners often produce some chemicals, lumber mills may produce some furniture, etc. These are considered to be secondary outputs of the industry. Thus, output defined on a commodity base includes only refined petroleum and excludes the output of chemicals, while the commodity output of chemicals includes the chemicals produced by petroleum refiners.

In most sectors of the economy, the proportion of secondary output in an industry does not exceed 5-10% on average, so that the levels of industry and commodity outputs are generally not very different. However, in a few sectors, the difference can be significant. The most striking example of such a sector is Radio and TV Broadcasting.

The output of this sector defined on and industry base includes all revenues earned by the radio and TV stations. However, most of these revenues accrue as a result of the sale of airtime for advertising purposes. Thus, the "secondary" output of the Radio & TV Broadcasting sector - which is advertising - is considered part of the Advertising sector's output, defined on a commodity basis. In the case of Radio and TV Broadcasting, real output defined on an industry base is very large ($13.6B in 1992) whereas output defined on a commodity base in extremely small ($0.78B in 1992).

Users of the Interindustry Model are accustomed to dealing with variables defined on a Commodity basis. However, users of the DRI U.S. and Regional economic models are accustomed to dealing with variables defined on an industry base, so the variables in the Regional Industry Forecasting System are defined on an industry base to facilitate complimentary use of these data with those from the economic models. DRI has developed the capability to report the variables from the Interindustry Model on both the commodity and the industry bases.

Appendix 5.
County Modeling System

County Modeling Service (CMS)

INTRODUCTION

Within counties in the state, there is variation among industries. For example, a plant closing in one county does not necessarily affect the surrounding counties. To account for the variation the County Modeling System provides forecasts of employment by one-digit SIC code (construction, mining, durable manufacturing, nondurable manufacturing, regulated industries, finance, services, trade, and government). In addition to establishing a framework for the introduction of variation, the county modeling system supplies more detailed forecasts of the level of activity at the county level. By increasing the level of disaggregation of the forecast, the accuracy of the forecast will increase. In the subsequent step of the overall model structure, the matrix balance, having a constraint that is less aggregate (the alternative would be total employment levels) increases the confidence in the forecast and decreases the computational difficulty of balancing the matrix.

Although employment is the main focus of this modeling exercise, the county modeling system forecasts consistent estimates of income and population. In other words, population and income estimates are consistent with the level of employment forecast within the model. Having this consistency insures that discussions of population growth are not made in isolation from other economic activity within the county.

I. MODEL STRUCTURE

I-1. Data Sources

Three major sources provide historical county economic concepts. Employment information at the one-digit Standard Industrial Classification (SIC) level come from the Bureau of Labor Statistics' comprehensive ES202 program. Income estimates, which include total personal income, wages and salaries, and non-wage personal income, are from the Bureau of Economic Analysis. In addition, the U.S. Bureau of Census publishes county-level population data. Since the latter two sources are available at an annual frequency, the CMS historical database and forecast are released at this frequency.

Another major database, used primarily in the section covering the generation of the manufacturing forecast, is the County Business Patterns database. The database contains annual historical data at the county level based on total employment figures, the number of establishments by size, and annual payrolls.

I-2. Manufacturing

As is the case in the Regional Information Service (RIS) regional, state and metropolitan area models, the manufacturing sector is the focus of the model, as it is this sector that drives the economic base of a given geographic area. Excluding portions of two manufacturing industries (food & kindred products, printing & publishing), the entire manufacturing sector is the major driver of the export market. Under this premise, and for the purpose of enhancing the significance of the procedure, the manufacturing sector was split into two separate sectors, the durable goods and non-durable goods industries. Using the County Business Patterns database, most recent level of employment for each of the twenty 2-digit manufacturing industries was retrieved. A generated durable manufacturing concept was developed. This concept was derived using the state's employment figure for that industry multiplied by the county's most recent share of the state total for the industry. This method is used for each of the twenty 2-digit manufacturing number is formed by adding those manufacturing sectors which comprise the durable goods sector (lumber & wood; furniture; stone, clay & glass; primary metals; fabricated metals; non electrical machinery; electrical machinery; transportation equipment; instruments; miscellaneous manufacturing). A similar method is used to derive a generated non-durable goods manufacturing concept.

While the generated manufacturing concepts are not the forecasted values for the county area, they are invaluable guides that are used concurrently with the employment forecasts in the forecasting procedure.

A ratio was formed analyzing the percent growth of the historical durable employment divided by the percent growth of the historical generated durable employment. Due to the availability of the annual data for all the counties, as well as the occasional disclosure problems, this ratio was held between 0 and 1.5; most of the counties were not affected, but in some cases the constraints were binding.

After using a similarly derived ratio for the non-durable manufacturing sector, a forecast was generated for both concepts across all counties by using the value of the concept in the year before multiplied by the ratio described previously, raised to an exponent which has the value of 1 in the first forecast year and declines to 0 over the forecast interval in order to converge the variation between the actual employment concept and the corresponding number derived using the generated employment concept explained earlier. The formula reads as follows:

$$EMD@CTY=EMD@CTY\backslash 1 * (RATIO)^{k} * (GEMD@ST/GEMD@ST\backslash 1)$$

where

EMD@CTY	= durable manufacturing in the county
EMD@CTY\1	= durable manufacturing in the county back one year
RATIO	= the ratio between the reported durable manufacturing employment concept and the generated manufacturing concept discussed earlier.
k	= exponent with value of 1 at the beginning of the forecast, declining to 0 at the end of the forecast interval.

This method produces a forecast for both durable and non-durable manufacturing employment, and a corresponding total manufacturing concept is obtained by adding the durable and non-durable manufacturing concepts together for every county in the nation. The total manufacturing concept can now be used to build the economic base for each county.

1-3. Base Employment

The economic base for a county varies depending on the composition of the area's economy, but a standard definition was needed for forecasting purpose. Total manufacturing, described previously, mining employment, federal government employment, and, in some cases, state and local government employment are generally assumed to play major part in the export side of an area's economy. While the state and local government sector is not generally regarded as a vital part in the economic base, there is a notable exception to this that most definitely adds the state and local government employment to the list - if the county in question happens to contain the state capital, it is assumed that the state and local government number is a part of the economic base. The state & local government concept for the remaining counties is assumed to react similarly to non-base employment concepts.

With this distinction clear, the economic base of a county is derived by using the forecast from the state (RIS) simulation at the rate level for mining, and federal and state & local government. The forecasts for these three concepts were generated by assuming that the county would move over time similar to the state, indexed to the county's latest historical share of the state number. This method was used for mining employment, federal government employment, and, for those areas that include the state capital, state & local government employment. An economic base employment concept for each county was thereupon derived by the combination of total manufacturing employment, mining, federal government employment, and if the area is the capital, state & local government is included.

I-4. Non-Base Employment

The forecast for the non-base employment concepts (construction; services; trade; transportation & communications; finance, insurance & real estate; and for non-capital areas, state & local government) was generated by relying quite heavily on both the historical and the forecasted relationship between the economic base at the county level, and the corresponding economic base at the state level. The forecast was derived identically for each of the non-base employment concepts. Using a corresponding definition of an area's economic base to create a state-level economic base concept, the change in the non-base

employment, for each county, divided by the change in that county's economic base employment, was forecasted to move similarly to the change in the corresponding non-base employment concept at the state level, divided by the change in the state's economic base employment. Again, this method was also used for the state & local government concept in those counties that do not include state capitals, and therefore, are not included in the definition of an area's economic base.

Upon completion of the manufacturing, base employment, and non-base employment sections, a total employment concept can be defined by summing the total manufacturing, mining, federal government, state & local government, construction, services, trade, transportation, communications & public utilities, and finance, insurance & real estate concepts together. This aggregate concept is vital in the remainder of the forecast process.

I-5. Income and Population

In addition to the employment section, there are five concepts included in the county coverage that fall under the "Income and Population" category. The methodology for forecasting population is slightly different from the structure used for creating the total employment wage rate, wage & salary disbursements, and non-wage taxable and non-taxable personal income.

The forecasting of the income section began with the derivation of a total employment wage rate. The change in the county wage rate was forecasted to move similarly to the change in the corresponding state's wage rate for total employment. A forecasted wage & salary disbursement term was then generated by multiplying the total employment wage rate by the total employment number for each county.

To derive a non-wage personal income variable over the forecast, the concept was actually split into two concepts: taxable and non-taxable non-wage non-taxable income. The derivation process for both components of non-wage income was the same: the county's non-wage income divided by the county's wage & salary disbursement was forecasted to move in a pattern similar to the corresponding *state's* non-wage income divided by the *state's* wage & salary disbursements, indexed to the same most recent historical ratio. After this method is employed for both non-wage taxable and non-wage non-taxable income, a total personal income concept is created by adding the wage and salary disbursement, non-wage taxable income, and non-wage non-taxable income terms. As is the case in the RIS Model, non-wage non-taxable income is made up of transfer payments and other labor income, such as employers' insurance payments. Non-wage taxable income is comprised of property income such as dividends, interest, or rent, proprietor's income of the self-employed, a residence adjustment term which is an effort to shift the income from place of work to place of residence, and a negative term reflecting personal deductions for Social Security.

The final concept included is population, and given the previously described method of creating a total employment term, the population concept for each county was forecasted by assuming that the change in the area's population divided by the change in the area's total employment will move similarly to the corresponding state's change in population divided by the change in total employment in the state. Based upon the structure outlined in the employment section, this methodology for the population variable produces a reliable forecast.

II. The Constraining Process

While the independent structure of the county models described above is an efficient method of analyzing the economy of a particular area, perhaps the most valuable insight occurs upon integrating the state forecasts from the RIS model and the metropolitan area forecasts from the MAFS model, along with the forecast for the 3,134 counties covered in this model.

Since the metropolitan area forecasts from the MAFS service are already constrained to the RIS state forecasts, a constraining mechanism to tie in the county forecasts with the RIS state and the MAFS metropolitan area forecasts can successfully be implemented by constraining the county forecasts to the metropolitan area forecasts, and the corresponding rural area, or non-MSA residual. The non-MSA counties are constrained to the "rural" or non-urban residual derived from subtracting the sum of all the metropolitan areas from the RIS state total. The formula is then defined to be:

CCON@CTY=UNCCON@CTY * (CON@MSA@MAFS/CON@CTYSINMSA)

where:

CCON@CTY	= constrained concept in the county
UNCCON@CTY	= unconstrained concept in the county (raw forecast described earlier)
CON@MSA@MAFS	= the constrained concept for the given metropolitan or non-MSA (rural) area from MAFS
CON@CTYSINMSA	= sum of the counties (unconstrained) located in the MSA (or the non-MSA residual)

This ratio is then applied multiplicatively to each concept, the result being a constrained concept that, when added to the similar concepts for each county within a state, will exactly be equal to the state number from RIS. All counties within a given metropolitan area will sum to the MSA number from MAFS. It is important to add here that the constraining process is done sector by sector, meaning that the constrained total manufacturing is the sum of the constrained durable and non-durable manufacturing concepts. This "bottom-up" approach enhances the accuracy of the forecast.

One further note is that the constraining process is done state by state, meaning that only the in-state portion of a metropolitan area is used when constraining the county forecast to an MSA which crosses the state borders. For example, the Cincinnati metropolitan area incorporates counties from three states: Ohio, Kentucky and Indiana. When the constraining of the county forecasts in Ohio is done, only the Ohio portion of the Cincinnati MSA is used in the numerator of the ratio in the equation above. This ensures that the sum of the counties in a state remains exactly equal to the RIS state forecast total.

The constraining procedure allows differences between urban and rural counties to be accounted for, and introduces a high degree of interaction among the counties in a particular state. Perhaps the greatest benefit, however, to existing clients of DRI's macro and regional services is the guarantee of consistency both horizontally and vertically in the summation of DRI's forecasts for different geographic areas within the country.

DEMOGRAPHICS

A. Population Cohorts

The springboard to future demographic applications is the population cohort breakdown, and these age-group splits were based on one general assumption. The idea is that given a state's present formation of age cohorts, it is assumed that this cohort formation pattern will continue, albeit at a slow rate. The actual level of age cohorts and the precise cohort mix will presumably differ, but there will not be a staggering change in the age group formation. Florida, for example, will continue attracting elderly residents, and while this rate will be slower in the future due to several characteristics including over-crowding and the increased attractiveness of Georgia and the Carolinas, there is no rationale for dramatically altering the make-up of the population.

Under this premise, historical data was retrieved from the Bureau of Census. Six age classes were defined, including 0-24, 25-34, 35-44, 45-54, 55-64, and 65 & over.

At his point, the technique was shifted to dealing with population cohort shares, since a forecast of shares will be many time more stable and reliable than dealing with levels. By dividing each cohort cell by the sum of the six cohorts, a county share number for each age class is derived. Similarly, an aggregate state share was generated by summing all the county cohort levels to derive the six state cohorts and then dividing each state cohort cell by the sum of the six state cohorts. The corresponding state-level forecasts for the six age classes were used from the Regional Information Service's (RIS) state and regional demographic model.

The actual county cohort forecast focused on generating an outlook for the county cohort shares, using the relative cohort shares for each state and the movement of the county share from 1970 to 1990 with respect to the change in the state share from 1970 to 1990. This ratio of the county share to the state share was raised to .05 in the first period of the forecast (due to the 20 yearly changes from 1970 to 1990 and given a value of 0 in 2050), with a linear interpolation for the middle years. The algorithm thus reads:

For annual, 1991 to 2001

$$\frac{CTYSHR}{CTYSHR\backslash 1} = \frac{STSHR}{STSHR\backslash 1} * \frac{CTYSHR[1990]/CTYSHR[1970]^{**}[1/N]}{STSHR[1990]/STSHR[1970]}$$

where:

CTYSHR = county cohort shares

STSHR = state cohort shares

N = 20 in 1991, linear interpolation to 0 in 2050

Since the county total population number was available through 2001 in the latest forecast, a cohort level forecast can be generated out to 2001 by multiplying each cohort share by the CMS county forecast for total population. Each new RIS long-term forecast will generate new population cohort forecasts, which will in turn enhance the RIS total population concept. This will then follow through to both the CMS and the RIS demographic concepts.

B. Households

The other extremely valuable concept in the demographic section of CMS is households by age cohort. Again, six cohort classes were defined, the major difference being that the first group starts at age 16, due to the Census definitions and the minimal amount of householders under that age. Actual households by the six age classes (16-24, 25-34, 35-44, 45-54, 55-64, 65 & over) were retrieved. Households for each cohort class for history and forecast were retrieved from RIS at the state level, and a corresponding state population number for each cohort class was similarly retrieved from RIS. A major assumption was

implemented at this point, since the cohort class likely to create problems was the newly-defined 16-24. The 1980 actual relationship between 16-24 and 0-24 was retrieved for each county, as well as at the state level. The 0-24 forecast was used for each county, as described in the first section. Then, using the state 16-24 numbers, the county 16-24 population number was assumed to grow with respect to the 0-24 number for each county at the same rate as the state-level ratio, yet indexed by the actual 1980 relationship. This is a concrete derivation of the first age class, given the initial forecasting procedure for the 0-24 age group.

A headship rate (households per population) was defined for all six age classes for all counties and states. The change in the individual county headship rates by cohort was then forecasted to move similar to the forecasted change in the state headship rates by cohort. A households number for each cohort cell was generated by multiplying the headship rates for each cohort by the forecasted county population cohorts, using the guidelines previously mentioned.

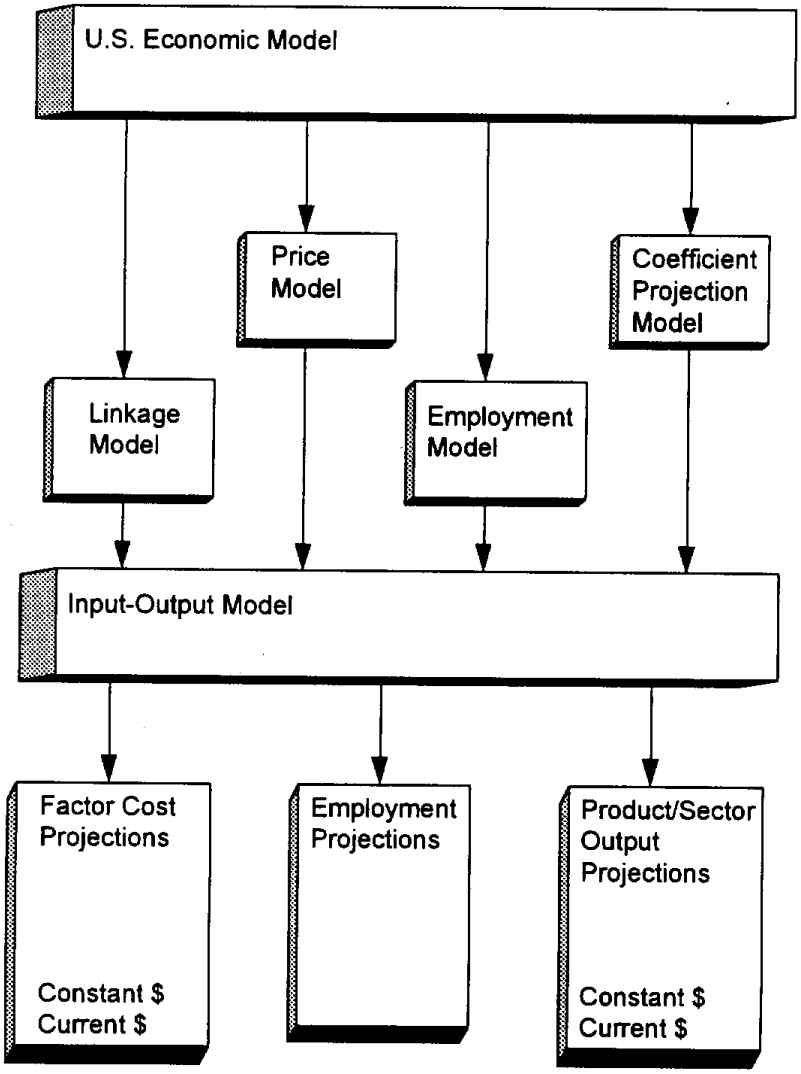
Appendix 6. The DRI Long-Term Interindustry Model

The DRI Long-Term Interindustry Model

Overview

The DRI Industry Information Service provides a flexible and comprehensive tool for evaluating the sensitivity of the output of individual sectors to government policies and to alternative macroeconomic scenarios. The core of this service, the input-output model, features a direct link to the DRI Model of the US Economy and the DRI Cost Forecasting Model, and traces the effects of cyclical fluctuations, inflation, and US economic events on end-market distribution of output for each sector.

Chart 6
The Input-Output Model System



The Industry Information Service integrates the output of several models and draws on data from a variety of sources. The basic input/output model describes deliveries from each sector to all other sectors plus output delivered directly to final demand. Individual interindustry transactions are explicit within the system, allowing users to trace exactly the sources and uses of any sector's demands and production. Data reflecting interindustry deliveries is obtained from the Department of Agriculture, the Department of Commerce, the Bureau of Mines, and the Annual Survey of Manufacturers. The input/output model is driven by final demand through a sectoral breakdown of GNP expenditure totals derived from the DRI Model of the US Economy. Prices associated with the specific macroeconomic scenario are computed by the DRI Cost Forecasting Service and are incorporated in the technical adjustments to the model and in the translation of values from constant to current dollars.

The Industry Information Service offers a variety of projections for 432 sectors at the four-digit SIC code level. To provide users with a model reflecting the most current technology, projections of the technical relationships which link industrial output are provided for each forecast horizon. The Service forecasts output in constant and current dollars, the accompanying price deflator, and employment levels.

The DRI Industry Information Service also maintains a high degree of adaptability in terms of model size. The 432-sector model can be aggregated according to client specification, retaining full detail in some sectors while aggregating in others. Moreover, the model can produce detail beyond the four-digit SIC code level.

The DRI Long-Term Interindustry Model uses input-output (I/O) methodology to analyze industrial activity and develop forecasts of industrial performance. The DRI I/O Model consists of a set of simultaneous output equations and a set of final demand equations which correspond to the individual sectors of the U.S. economy. DRI's Interindustry Model identifies 432 sectors, with additional detail in the service sectors and in electronic components, and 169 final demand components.

The DRI model is based on the 1977 input-output table prepared by the Bureau of Economic Analysis (BEA), U.S. Department of Commerce. In DRI's model, the input-output coefficients can be adjusted to account for technological change and changes in the mix of U.S. industrial product use. The model is linked with the DRI Quarterly Model of the U.S. Economy in order to ensure consistency between the macroeconomic and industrial forecasts. Sectoral concepts identified in the model include real and nominal output, prices, exports, imports, employment and productivity at approximately the 4-digit SIC level of detail.

The Long-Term Interindustry Model produces annual forecasts over a 10-year horizon, and can be used to extend forecasts as far as 30 years.

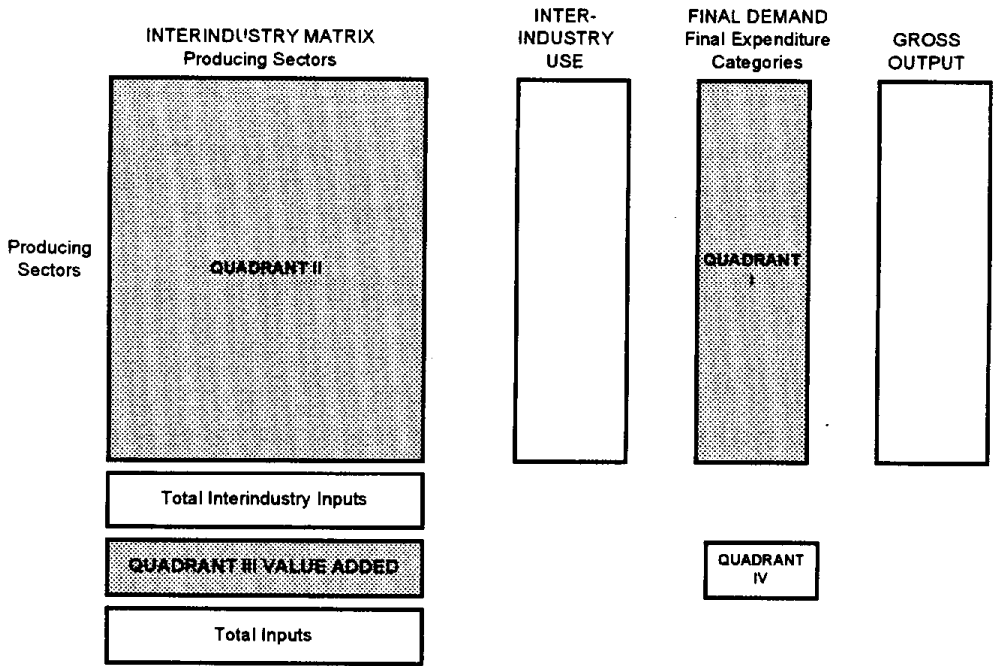
Input/Output Methodology

An input-output model is essentially a model of production which takes into account the interdependencies among sectors in the overall production process. The basic structural unit of DRI's model is the producing sector (or industry). A producing sector is defined as the aggregation of firms producing the same product and employ similar techniques of production. The structural classification scheme for DRI's model identifies 432 sectors, including a separate sector for the U.S. Postal Service.

The DRI Model uses an input-output table based on the BEA table in which each sector is represented twice -- once as a row showing the distribution of its output and once as a column showing its purchases of inputs. The table is considered to portray the technology of production activities within the economy. Since technology remains relatively stable over time, it provides a firm foundation for analyzing the interindustry flows within the economy as well as forecasting future economic performance.

The distinction between intermediate and final users of sectoral outputs and the purchases of intermediate (produced) and primary (labor and capital) inputs enable the input/output table to be divided into four quadrants, as depicted in Chart 7.

Chart 7
Format of the Input-Output Table



- Quadrant I records the deliveries of sectoral outputs to final demand
- Quandrant II shows the deliveries of outputs among all producing sectors of the economy.
- Quandrant III records the purchases of primary inputs by each producing sector. These transactions can be disaggregated into component series such as employee compensation, capital consumption allowances, indirect business taxes and profit-type income.
- Quadrant IV shows payments to primary factors by final expenditure categories. Although the inclusion of these transactions is necessary for the input/output table to be consistent with the national income and product accounts, alternative accounting procedures are usually followed which allow these transactions to be identified in Quadrants I and III.

Three features are key to the utility of the input/output table:

Adding horizontally, the deliveries to industries plus the deliveries to final demand equal gross output for each producing sector, or the *endmarkets*.

Adding vertically, each sector's purchases of inputs from other sectors (and itself) and from primary factor suppliers equal total inputs. The vertical pattern of input purchases reflects the mix of inputs, and implicitly, the *production function*, used to produce each sector's output.

Each producing sector's row total (gross output) is equal to its column total (total inputs). This accounting system insures that total revenue generated from output sales is used to purchase inputs or ends up in profits.

Intermediate Demand

The materials and supplies required by industries is specified in the 432x432 input-output table. The table is based on the benchmark studies done every five years by the US BEA; the current DRI table is based on the 1977 benchmark, but has been updated to 1981 controls. The real dollar value of output is expressed in 1977 dollars, as is the BEA I/O table. The 1981 controls refer to the interim buyer-supplier surveys conducted by the BEA; these controls are also measured in 1977 dollars. As seen below, DRI uses a statistical technique to "update" the rows of the I-O table to 1991 and to forecast their trends over the long term. (Note: the release of the 1987 benchmark I-O table has been delayed for several years by the BEA. DRI expects the release of a new table, perhaps updated to 1992, sometime during 1994) In any year, the direct requirement for inputs by any industry is assumed to be proportional to its output, which is a fundamental assumption that makes the I-O table an operative concept.

As equations:

(1) PRODUCTION = SALES TO FINAL USERS (including inventories) + SALES TO OTHER INDUSTRIES

or, using matrix notation:

$$q = f + Aq$$

where **q** is production, **f** is final demand (represented by the **B**- or bridge matrix described below), and **A** is the I-O table containing the amount of input needed from other industries to produce one dollar's worth of output. This simultaneous system is solved using iterative techniques, avoiding the need to calculate

$(I - A)^{-1}$ (the "Leontief Inverse") each year.

The A-matrix and B-matrix are not static, but rather are forecast to change each year. With the A-matrix this is done through rowscalers. A rowscaler is an index measuring intensity of use over time across all markets, for every industry. In the forecast, it is used to multiply all elements in one row of the matrix. Since each row of coefficients represents the usage of that industry as an input into all other industries, the row scalar multiplies the proportion of input usage into all other industries by the same factor for each year. The rowscaler forecasts are created through a combination of regression analysis on historical data and judgment

For example, to calculate the row scalar for the steel industry, we would compare actual historical input usage of steel versus the historical input usage that would be calculated with a constant A-matrix. The ratio of these two numbers would be the historical row scalar, i.e., the amount by which all coefficients in the steel row would have to be multiplied to be consistent with historical data. A regression would then be run using the historical row scalar as the dependent variable, and using a curvilinear time trend and potentially other variables as regressors. The forecast from this equation would be used as the row scalar for steel in the forecast. Therefore, since steel input usage has been declining for the last 20 years, the regression equation would forecast a falling row scalar for steel, which would translate into falling coefficients in the forecast. For some industries, the row scalars calculated from regression analysis may not be consistent with other information we have about that industry. Therefore, for some industries, row scalars are derived using informed judgment. For the years 1982 to 1991, actual data is available on output and final demand, from which we can derive a control total for intermediate demand. For these historical years, row scalars are created to make the results of a historical I-O simulation consistent with historical data.

Solving for Output by Industry

The solution for output in the I-O model does not use the Leontief inverse matrix directly, but rather solves using an iterative technique called the Gauss-Seidel technique. This technique is used because it is much faster than calculating the inverse matrix for each year of the forecast, and it is just as accurate. We can think of the process in terms of the identity:

$$(I - A)^{-1} = I + A + A^2 + A^3 + A^4 + \ldots$$

Intuitively, this identity expresses the multiplier impact of a change in final demands. The equation says that total requirements resulting from a given level of final demands equals the direct impact, plus the first round input requirements of the direct impact, plus the second round input requirements resulting from the first round, all the way to the nth round, when the process converges. Usually about 8 to 10 iterations are required with the current model, even taking into account the addition of simuultaneously-determined imports as discussed above. When the output calculation has converged for each year, the I-O model solution is complete.

DRI's Extensions of the Basic I/O Model

DRI's Interindustry Model enhances the basic input-output methodology in four ways:

- The input-output model has been extended to describe the relationships between final expenditures and sectoral production in more detail. Via this extension, the DRI Interindustry Model can be linked directly to final demand estimates produced by the DRI Quarterly Model of the U.S. Economy.
- A separate model is included in the DRI version to adjust input-output coefficients to account for technological change and observed or forecasted changes in product use.
- A sector price model was developed and linked to the DRI Cost Forecasting Model. The sector price model provides price estimates for the 432 sectors identified in the DRI Interindustry Model.
- DRI has updated the BEA 1977 input-output table to 1981.

Linking Final Expenditures and Sectoral Production

The DRI Interindustry Model is intended for use in both simulation and forecasting. In forecasting exercises, estimates of final demand must be supplied for each period in the forecast interval. Within the DRI Interindustry Model, total final demand (or Gross National Product) is disaggregated into the final expenditure categories of the National Income and Product Accounts(e.g., consumption, investment, exports, imports, and government expenditures). Deliveries from each sector to total final demand are disaggregated along the same lines. The result of this disaggregation is a matrix of flows from each sector to each final demand category.

The flow matrix is converted into a 'bridge' matrix of coefficients by dividing the deliveries of each final demand category by total expenditures for the corresponding type of final demand, i.e., each cell is divided by the column total. This bridge matrix enables final expenditures forecasted by the DRI Quarterly Model of the U.S. Economy to be incorporated into sectoral production forecasted by the DRI Interindustry Model.

Final Demand

The I-O model answers the question of how much production is going to be required, by industry, for a specified level and distribution of final demand in the economy. Thus the final demand forecast is the first critical step in the calculation. Final demand forecasts are prepared for 167 categories, nearly half of which are various types of consumer spending. Construction and capital equipment demand (by type of equipment) are represented by nearly 60 categories, while foreign trade and government spending make up the remainder. When preparing the Baseline forecast twice each year, DRI's staff forecasts each of the 167 categories using a variety of econometric techniques.

When performing a Macro / I-O simulation, or a "what-if" scenario, the entire set of 167 final demands is usually reduced to the basic set of 50 that are generated within the core Macro model. For example, there are 15 PCE categories in the Macro Model, whereas the DRI Interindustry Model produces a table of 75

consumption categories corresponding to the detailed PCE table in the NIPA. For a simulation, the 15 categories are solved for, and the results allocated among the 75 detailed pieces. This automated process makes it very easy to link new macro simulations to I-O system.

Once all final demands are known, they must be redefined in terms of the industry categories that produce the specified goods and services. For example, within the category called "Capital Equipment: General Industry Machinery," DRI breaks out Blowers and Fans as distinct from Power transmission equipment. The basic table that contains the data to do this allocation is called a Bridge Matrix, usually denoted as "B". At this point we have an estimate of final demand by industry, with the exception of most imports.

A new DRI innovation in 1993 was the introduction of endogenously-determined imports by industry. Rather than using the above procedure, we recognize that imports are determined largely by domestic consumption of that industry's product, plus relative foreign-to-domestic price ratios, including the exchange rate effect. Incorporating this into the I/O model requires (a) a set of econometric import equations, or at least an exogenous set of import penetration rates; and (b) a major revision in the solution process that causes imports and output to be solved simultaneously. The discussion below abstracts from this complexity in order to explain the basic model and forecast process most clearly.

Introducing Technological Change

The DRI Interindustry Model includes a system for projecting input-output coefficients to account for technological change and changes in the mix of products used, by industry. This system is also applied to the elements of the bridge matrix, allowing the sectoral composition of final expenditures to shift over time. DRI incorporates both sector-specific engineering data (e.g., automobile energy efficiency standards) and changes in mix or input structures observed over time.

Sector Price Model

The Sector Price Model links price and inflation variables forecasted by the DRI Quarterly Model of the U.S. Economy and DRI Cost Forecasting Model to individual sectors in the DRI Interindustry Model. Where cost forecasting variables are not available, the Sector Price Model estimates cost of production as a weighted average of the prices of intermediate and primary inputs used in the sector's production process, and measures of market tightness. To incorporate client-specific inflation assumptions, the Sector Price Model uses 'reflective ratios' to factor in changes in aggregate prices for a sector (e.g., metals) while keeping relative prices (e.g., steel versus aluminum) in line with the output of the DRI Cost Forecasting Model.

1981 Update

The DRI Interindustry Model is based on the 1977 input-output table prepared by the Bureau of Economic Analysis (BEA), U.S. Department of Commerce. Because technology and consumption patterns change over time, however, DRI sought to enhance the accuracy of the model by updating the bridge and technical coefficients to reflect documented changes in the economy's sectors. The new estimates reflect 1981 coefficients, incorporating the widespread penetration of computers as a business tool, and the onslaught of foreign goods into domestic markets. The use of 1981 coefficients also captures the functioning of the economy in a non-recessionary year.

Forecast Concepts

The DRI Interindustry Model forecasts real and nominal output, prices, exports, imports, employment, and productivity at approximately the 4-digit SIC level of detail.

Output is calculated as shipments plus the change in work-in-process and finished goods inventories. This definition allows production to exceed current consumption during periods of inventory accumulation and, conversely, lowers output levels during drawdown. Inventories are allocated to the producing sector, rather than the holding sector (wholesale, retail, raw material) using the information

provided by the U.S. Department of Commerce *Census of Wholesale and Retail Trade*, as well as the BEA input-output table.

Data Sources

Table 1 (on the following page) identifies the government publications used as sources of data for the DRI Long-Term Interindustry Model.

Table 6
Data Sources
DRI Long-Term Interindustry Model

I	**Shipments**		
		Manufacturing	International Trade Administration U.S. Department of Commerce
II	**Inventories**		
		Manufacturing	International Trade Administration U.S. Department of Commerce
		Agriculture	'Farm Income Situation' Release U.S. Department of Agriculture
III	**Output**		
		Agriculture	Gross Receipts From Farming U.S. Department of Agriculture
		Construction	National Income and Product Accounts Purchases of Structures by Type: Tables 5.4 and 5.5
		Other: Non-Manufacturing	BLS Time Series for Input-Output Industries U.S. Department of Labor
IV	**Prices**		
		Manufacturing	International Trade Administration U.S. Department of Commerce Producer and Consumer Price Indexes - BLS U.S. Department of Labor
		Agriculture	Prices Paid to Farmers U.S. Department of Agriculture
		Construction	National Income and Product Accounts Purchases by Structures by Type: Tables 5.4 and 5.5
		Mining	BLS Time Series for Input-Output Industries U.S. Department of Labor *Monthly Energy Report* U.S. Department of Energy
		Other: Non-Manufacturing	BLS Time Series for Input-Output Industries U.S. Department of Labor Producer and Consumer Price Indexes U.S. Department of Labor
V	**Exports and Imports**		
		Manufacturing	International Trade Administration U.S. Department of Commerce Detailed Monthly Trade Monitor DRI/McGraw-Hill, Inc.
		Agriculture	U.S. Department of Agriculture
		Mining	*Mineral Industry Surveys* U.S. Department of Interior *Monthly Energy Report* U.S. Department of Energy
		Other: Non-Manufacturing	National Income and Product Accounts Merchandise Exports and Imports by Type of Product and End Market Category: Tables 4.3 and 4.4 U.S. Department of Commerce
VI	**Employment**		
		Manufacturing	International Trade Association U.S. Department of Commerce Annual Survey of Manufacturers U.S. Department of Commerce
		Non-Manufacturing	Bureau of Labor Statistics U.S. Department of Labor

All sector time series data were constructed by using the 1977 benchmark levels provided by BEA and indexing them with appropriate data sources. All industry data were converted to a product base by DRI.

Appendix 7. DRI's U.S. Macroeconomic Model

Philosophy and Properties of the DRI Model of the U.S. Economy

Since 1968, DRI/McGraw-Hill has worked to advance the science of economic forecasting and policy analysis and, in doing so, to deliver substantial information to business and government. The latest version of the DRI Model of the U.S. Economy remains firmly in this tradition by:

- Responding to the constructive criticisms of both economics and econometric models that have arisen during the 1980s with a new, robust tool;
- Rigorously checking all equation specifications, coefficients, and model simulation properties; and
- Backing this effort with an extensive program of documentation and professional support.

Because of the enormous complexity of the economy, an economic model is a necessity for business planning, government policy analysis, and academic instruction. Financial, spending, production, wage-price, and international trade decisions all feed into each other. Significant lags and leads complicate the understanding of these cause-and-effect chains, and hence make difficult the prediction of future behavior and the interpretation of current conditions. Model design must incorporate this complexity but also provide realistic, reliable results.

The Model's Theoretical Position

The DRI Model incorporates the best insights of many theoretical approaches to the business cycle: Keynesian, neoclassical, monetarist, supply-side, and rational expectations. In addition, the DRI model embodies the major properties of the long-term growth models presented by James Tobin, Robert Solow, Edmund Phelps, and others. This structure guarantees that robust long-run properties will temper short-run cyclical developments.

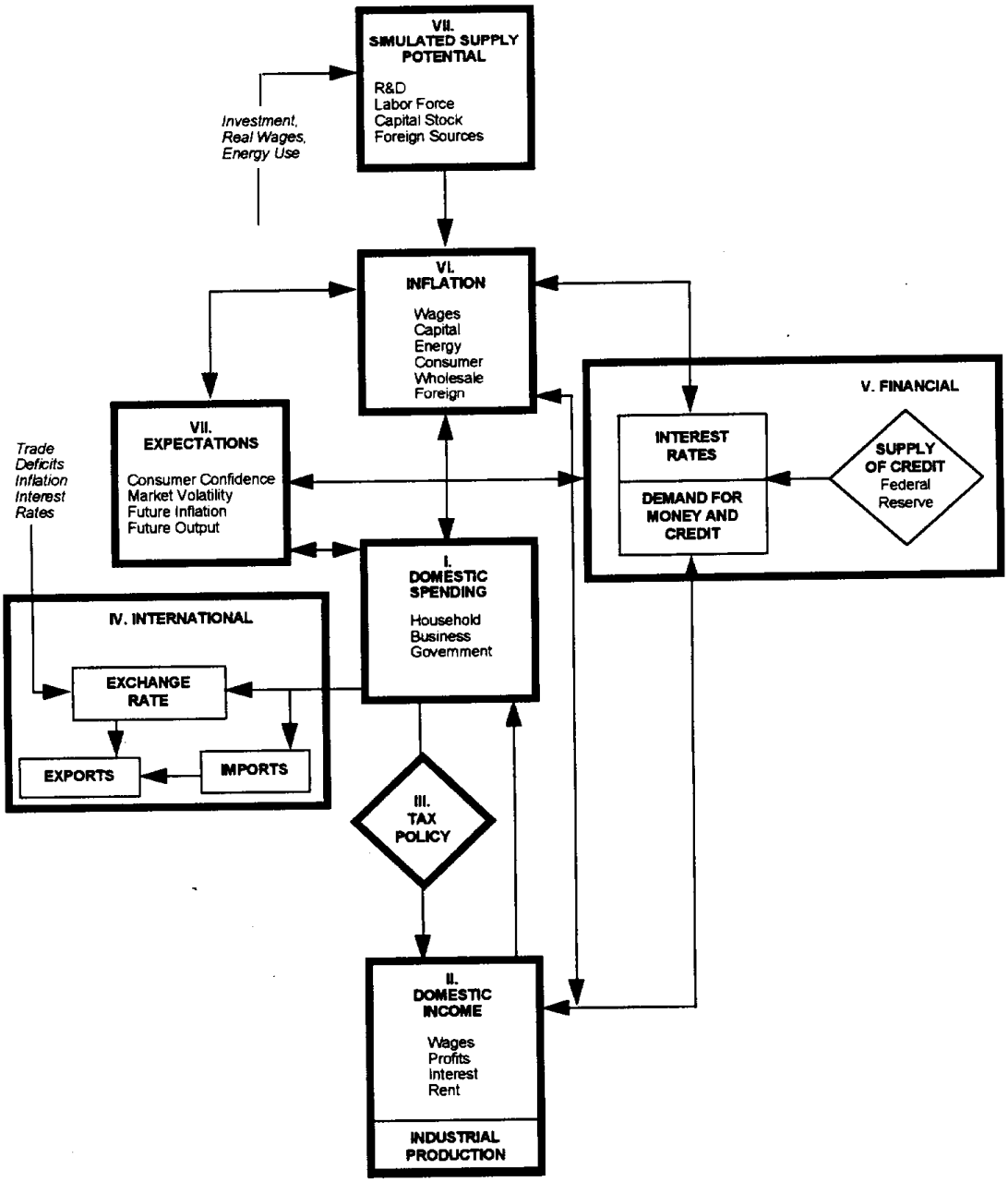
In growth models, the expansion rate of technical progress, the labor force, and the capital stock determine the productive potential of an economy. Both technical progress and the capital stock are governed by investment, which in turn must be in balance with post-tax capital costs, available savings, and the capacity requirements of current spending. Thus, for example, monetary and fiscal policies will influence the short- and long-term characteristics of such an economy through their impacts on national saving and investment. A modern model of output, prices, and financial conditions is melded with the growth model to present the detailed, short-run dynamics of the economy.

The model pays due attention to valid lessons of monetarism by carefully representing the diverse portfolio aspects of money demand and by capturing the central bank's role in long-term inflation phenomena. The DRI Model also embodies supply-side hypotheses to the extent supportable by available data, and this is considerable in the many areas that supply-side hypotheses share with long-run growth models. These supply features have been fundamental ingredients of the Model since 1976. Finally, the DRI model acknowledges the important role of rational expectations with clearly identified expectations variables established as prominent components: consumer sentiment, inflation expectations, interest rate volatility. Throughout the model, the theoretical basis of each equation is thoroughly worked out before regression analysis is initiated, upholding the integrity of the model as a whole.

Major Sectors of the U.S. Model

The DRI Model captures the full simultaneity of the U.S. economy, forecasting over 1200 concepts spanning final demands, aggregate supply, prices, incomes, international trade, industrial detail, interest rates, and financial flows. Chart 1 summarizes the structure of the eight interactive sectors (noted in Roman numerals). The following discussion briefly presents the logic of each sector and the significant interactions with other sectors.

Chart 8
Overview of the DRI/McGraw-Hill Macroeconomic Model



Spending-Consumer: The domestic spending (I), income (II), and tax policy (III) sectors model the central circular flow of behavior as measured by the national income and product accounts. If the rest of the model were "frozen," these blocks would produce a Keynesian system similar to the models pioneered by Tinbergen and Klein.

Consumer spending is divided into three durable goods categories (autos and parts, furniture, and "other"); five nondurable goods categories (food, clothing and shoes, gas, fuel, and "other"); and eight service categories (housing, transportation, three household operation subcategories, medical, financial services, and "other"). In nearly all cases, real expenditures are motivated by real income and the price of a particular category relative to the prices of other consumer goods. Durable and semidurable goods are also especially sensitive to household net worth, current financing costs, and consumer speculation on whether it is a "good time to buy." The University of Michigan Survey of Consumer Sentiment monitors this last influence, with the index itself modeled as a function of current and lagged values of inflation, unemployment, and the prime rate.

Spending-Business Investment: Business spending includes six fixed investment categories (autos, office equipment, other producer durables, public utility structures, mining and petroleum structures, and buildings and other structures) and five inventory spending categories (farm, manufacturing, wholesale, retail, and "other"). Equipment and non-utility, non-mining, structures spending is determined by the effective post-tax capital costs, capacity utilization, and replacement needs. The cost terms are sophisticated blends of post-tax debt and equity financing costs (offset by expected capital gains) and the purchase price of the investment good (offset by possible tax credits and depreciation-related tax benefits). This updates the well-known work of Dale Jorgenson, Robert Hall, and Charles Bischoff.

Given any cost/financing environment, the need to expand capacity is monitored by recent growth in national goods output. Public utility structure expenditures are motivated by similar concepts except that the output terms are restricted to electricity and gas utility output rather than total national goods output. Net investment in mining and petroleum structures responds to movements in real domestic oil prices and to the energy demands of the economy.

The fixed investment equations are very sensitive to changes in the economy because of their Bischoff-based specification. The estimated structure, with a clear separation of output and capital cost influences into change and level components, enhances the accelerator properties of the model. This, we believe, definitely improves its cyclical sensitivity but not at the expense of its long-run properties; its long-run properties remain robust because replacement needs are constrained to match the depreciation rates used to create corresponding capital stocks, and the capital stocks determine consistent estimates of capacity. These capacity measures, when contrasted with current and expected output, drive investment, wage, and price decisions.

Inventory demand is the most erratic component of GNP, reflecting the procyclical, speculative nature of private sector accumulation during booms and decumulation during downturns. The forces that drive the four nonfarm stock categories are changes in spending, short-term interest rates and expected inflation, surges in imports, and changes in capacity utilization or the speed of vendor deliveries. Surprise increases in demand lead to an immediate drawdown of stocks and then a rebuilding process over the next year; the reverse naturally holds for sudden reductions in final demand. Inventory demands are sensitive to the cost of holding the stock, measured by such terms as interest costs adjusted for expected price increases and by variables monitoring the presence of bottlenecks. The cost of a bottleneck that slows delivery times is lost sales: an inventory spiral can therefore be set in motion when all firms accelerate their accumulation during a period of strong growth but then try to deplete excessive inventories when the peak is past.

Spending-Housing: Residential construction is typically the first sector to turn down in a recession and the first to rebound in a recovery. Moreover, the magnitude of the building cycle is often the key to that of the subsequent macroeconomic cycle. This is as true today as in past decades, although changes in financial market regulation have altered this sector's behavior. Up until the 1980s, surges in housing were produced by "disintermediation", i.e., cyclical losses and gains of deposits at thrift institutions (which were bound by the Regulation Q deposit-yield ceiling) to alternative investment media as market interest

rates rose or fell. With the removal of such ceilings, mortgage lenders—as well as homebuilders and buyers—can now obtain construction funds if they are willing to pay a competitive interest rate. Buyers are thus being priced out of the market by a high yield rather than rationed out by an absence of funds.

The housing sector of the DRI Model reflects this change, explaining new construction as a decision primarily based on the after-tax cost of homeownership relative to disposable income. This cost is estimated as the product of the average new home price adjusted for changes in quality, and the mortgage rate, plus operating costs, property taxes, and an amortized downpayment.

Due to the change in financial regulations, the equations for single- and multi-family housing are based only on data from 1978 through 1992. This brief estimation interval could potentially create problems for long-term forecasting except that the equations also include a careful specification of demographic forces. After estimating the changes in the propensity for specific age-sex groups to form independent households, the resulting "headship rates" were multiplied by corresponding population statistics to estimate the trend expansion of single- and multi-family households. The housing equations were then specified to explain current starts relative to the increase in trend households over the past year, plus pent-up demand and replacement needs. The basic phenomenon being scrutinized is therefore the proportion of the trend expansion in households whose housing needs are met by current construction. The primary determinants of this proportion are housing affordability, consumer confidence, and the weather. Actual construction spending in the GDP accounts is the value of construction "put-in-place" in each period after the start of construction (with a lag of up to six quarters in the case of multi-family units), plus residential improvements, and brokerage fees.

Spending-Government: The last sector of domestic demand for goods and services, that of the government, is largely exogenous (user-determined) at the federal level and endogenous (equation-determined) at the state and local level. The user sets the real level of federal nondefense purchases of goods and services, defense purchases, transfer payments, and grants to state and local governments. The model calculates the nominal values through multiplication by the relevant estimated prices. Changes in interest payments are determined by changes in the debt (the current deficit) and changes in the average interest rate as debt is expanded or rolled over.

The presence of a large and growing deficit imposes no constraint on federal spending. This contrasts sharply with the state and local sector where legal requirements for balanced budgets mean that declining surpluses or emerging deficits produce both tax increases and reductions in spending growth. State and local purchases of goods and services are also driven by the level of federal grants (due to the matching requirements of many programs), population growth, and trend increases in personal income.

Production: The industrial production sector includes 60 standard industrial classifications (SIC). Production is a function of various cyclical and trend variables and a "generated" output term, i.e., the input-output (I-O) relationship between the producing industry and both intermediate industries and final demand. In other words, generated output terms are carefully constructed averages of the activity levels in the markets to which the industry sells. The cycle and trend variables correct for changes in I-O coefficients that are implied by the changing relationships between buyers and sellers. This structure guarantees a reliable transformation from the basic final demand indicators into detailed, market-specific production indicators. The model performs these calculations automatically during each solve command, delivering immediately useful information for business planning without additional effort by the user.

Income: Domestic spending, adjusted for trade flows, defines the economy's value-added or gross national product. Because all value-added must accrue to some sector of the economy, the expenditure measure of GNP also determines the nation's gross income. The distribution of income among households, business, and government is determined in sectors II and III of the model.

Pre-tax income categories include private and government wages, corporate profits, interest, dividends, rent, and entrepreneurial returns. Each pre-tax income category except corporate profits is modeled as a function of wages, prices, interest rates, debt levels, and capacity utilization or unemployment rates. Profits are logically the most volatile component of GNP on the income side. When national spending changes rapidly, the contractual arrangements for labor, borrowed funds, and energy imply that the return

to equity holders is a residual that will soar in a boom and collapse in a recession. The model reflects this by calculating wage, interest and rental income as thoroughly reliable near-identities (e.g., wages equal average earnings multiplied by hours worked) and then subtracting each non-profit item from national income to solve for profits.

Taxes: Since post-tax rather than pre-tax incomes drive expenditures, each income category must be taxed at an appropriate rate; the model therefore tracks personal, corporate, payroll, and excise taxes separately. Users may set federal tax rates; tax revenues are then simultaneously forecast as the product of the rate and the associated pre-tax income components. However, the model automatically adjusts the effective average personal tax rate for variations in inflation and income per household, and the effective average corporate rate for credits earned on equipment, utility structures, and R&D. With the exception of corporate profits and social insurance tax rates, state taxes are fully endogenous: the Model makes reasonable adjustments automatically to press the sector toward the legally-required approximate budget balance. The average personal tax rate rises with income and falls with the government operating surplus. Property and sales taxes provide the bulk of state excise revenue and reflect changes in oil and natural gas production, gasoline purchases, and retail sales, as well as revenue requirements. The feedback from expenditures to taxes and taxes to expenditures works quite well in reproducing both the secular growth of the state and local sector and its cyclical volatility.

International: The international sector (IV) is a critical, fully simultaneous block that can either add or divert strength from the central circular flow of domestic income and spending. Depending on the prices of foreign output, the U.S. exchange rate, and competing domestic prices, imports capture varying shares of domestic demand. Depending on similar variables and the level of world gross domestic product, exports can add to domestic spending on U.S. production. The exchange rate itself responds to international differences in inflation, interest rates, trade deficits, and capital flows between the U.S. and its competitors. In preparing forecasts, DRI's U.S. Economic Service and the World Service collaborate in determining internally consistent trade prices and volumes, interest rates, and financial flows.

Export and import details for business machines is included as a natural counterpart to the inclusion of the office equipment component of producers' durable equipment spending. The business machines detail allows more accurate analysis because computers are rapidly declining in effective quality-adjusted prices relative to all other goods, and because such equipment is rising so rapidly in prominence as businesses push ahead with new production and information processing technologies.

Investment income flows are also explicitly modeled. The stream of huge current account deficits incurred by the U.S. during the 1980s, and the prospects for continued large deficits in the years ahead, have important implications for the U.S. investment income balance. As current account deficits accumulate, the U.S. net international investment position and the U.S. investment income balance deteriorate. U.S. foreign assets and liabilities are therefore included in the model, with the current account deficit determining the path of the net investment position. Investment income flows are modeled as rates of return on the corresponding foreign asset and liability categories.

The reactions of overseas prices, interest rates and GDP to U.S. development are robust and automatic. In the case of a dollar depreciation, for example, U.S. activity may expand at the expense of foreign activity and U.S. inflation may rise while the rate in other countries slows.

Financial: The use of a detailed financial sector (V) and of interest rate and wealth effects in the spending equations recognizes the importance of credit conditions on the business cycle and on the long-run growth prospects for the economy.

Interest rates, the key output of this sector, are modeled as a term structure, pivoting off the federal funds rate, the discount rate, and the Treasury bill rate. These short-term rates depend upon the balance between the demand and supply of reserves to the banking system. The supply of reserves is the principal exogenous monetary policy lever within the model, reflecting the Federal Reserve's open market purchases or sales of Treasury securities. Banks and other thrift institutions demand reserves to meet the reserve requirements on their deposits and the associated (exogenous) fractional reserve requirements. The

private sector in turn demands deposits of various types, depending on current yields, income, and expected inflation.

Longer-term interest rates are driven by shorter-term rates as well as factors affecting the slope of the yield curve. In the DRI Model, such factors include inflation expectations, government short- and long-term borrowing requirements, corporate financing needs, and the recent volatility of interest rates. The expected real rate of return varies over time and across the spectrum of maturities. An important goal of the financial sector is to capture both the persistent elements of the term structure and to interpret changes in this structure. Twenty-four interest rates are covered in order to meet client needs regarding investment and financing allocation strategies.

Inflation: Inflation (VI) is modeled as a carefully-controlled, interactive process involving wages, prices, and market conditions. Equations embodying a near accelerationist point of view produce substantial secondary inflation effects from any initial impetus such as a change in wage demands, a rise in foreign oil prices, or an increase in excise taxes. Unless the Federal Reserve expands the supply of credit, real liquidity is reduced by any such shock; given the real-financial interactions described above, this can significantly reduce growth. The process also works in reverse: a spending shock can significantly change wage-price prospects and then have important secondary impacts on financial conditions.

The principal domestic cost influences are labor compensation, nonfarm productivity (output per hour), and foreign input costs; the latter are driven by the exchange rate, the price of oil, and foreign wholesale price inflation. This set of cost influences drives each of the eighteen industry-specific producer price indexes, in combination with a demand pressure indicator and appropriately weighted composites of the other seventeen producer price indexes. In other words, the inflation rate of each industry price index is the reliably-weighted sum of the inflation rates of labor, energy, imported goods, and domestic intermediate goods, plus a variable markup reflecting the intensity of capacity utilization or the presence of bottlenecks. If the economy is in balance—with an unemployment rate near 5%, manufacturing capacity utilization steady near 80-85%, and foreign influences neutral—then prices will rise in line with costs and neither will show signs of acceleration or deceleration.

Supply: The growth of aggregate supply (VII) is the fundamental constraint on the long-term growth of demand. When the economy's supply potential exceeds aggregate demand, deflationary pressures are created which lower credit costs and strengthen consumer sentiment. This stimulates aggregate demand, raising it up to the level of aggregate supply. Conversely, inflation created by demand in excess of potential GDP raises credit costs and weakens consumer sentiment, thus putting the brakes on aggregate demand when the economy is overheating.

Aggregate supply, the economy's potential GDP, is estimated within a production function framework with explicit labor, business capital, energy, and research and development inputs. Total factor productivity of labor, capital, and energy is driven by research spending and trends to reflect technological progress.

Expectations: The contributions to the Model and its simulation properties of the rational expectations school are as rich as the data will support. The principal nuance relating to expectations (VIII) in the DRI Model is an endogenous volatility factor influencing interest rates. Volatility, as measured by the difference between the monthly minimum and maximum values of the Treasury bill rate, increases significantly with Federal Reserve "changes of regime," shifts in wholesale price inflation and oil price shocks. Volatility adds moderately to the level of short-term rates and, by increasing the risk of investment, has an even greater impact on long-term rates. The presence of this variable allows users to achieve (and to enhance at will) the types of non-Keynesian influences stressed by the rational expectations theorists. The same may be said of the other expectation variables in the model: consumer sentiment (in household durables and semidurables), inflation expectations (in interest rates and capital spending), and growth expectations (in business investment).